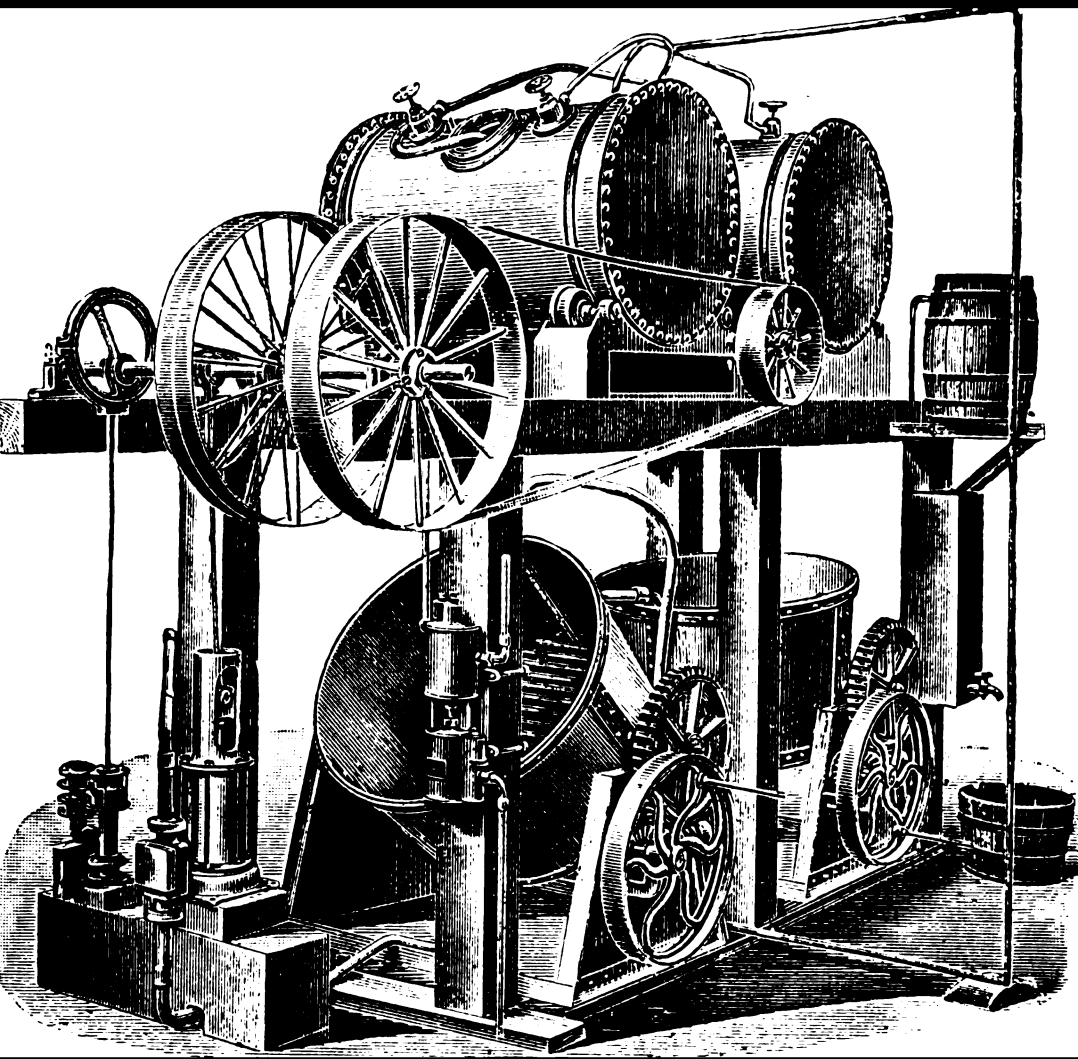

Illustrated handbook of machinery

Charles James Appleby

LAWI

2

APPLEBY'S ILLUSTRATED HANDBOOK OF MACHINERY.

SECTION VI.

PART A.—MINING MACHINERY,

INCLUDING

PLANT FOR TREATING QUARTZ, TAILINGS AND CONCENTRATES; PROSPECTING MACHINERY, HYDRAULIC GIANTS AND MINE PUMPS, WINDING ENGINES, ROPE TRAMWAYS, TRUCKS, VENTILATORS, &c.

PART B.—COLONIAL & MANUFACTURING MACHINERY,

FOR TREATING

CORN, COFFEE, RICE, SUGAR, COTTON, AND OTHER PRODUCTS, OIL MILLS, ICE MAKING, DISTILLING, &c.

WITH

PRICES, WEIGHTS, MEASUREMENTS, AND SOME DATA ON WORKING EXPENSES AND RESULTS OBTAINED.

BY

C. J. APPLEBY, M. Inst. C.E.,

[JESSOP & APPLEBY BROS., (LEICESTER & LONDON,) LIMITED.]

22, WALBROOK, LONDON, E.C.

Telegraphic Address—"MILLWRIGHT, LONDON."

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APPLEBY'S HANDBOOK OF MACHINERY.

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The Edition published in 1869, and several reprints of it having been exhausted, a New Edition (of which this section forms a portion) is now being completed; and for the convenience of those who desire information on specific subjects, but not on all those treated, the book is divided into seven sections, each of which may be obtained separately as follows:—

SECTION 1.—**PRIME MOVERS.**

STEAM, GAS AND AIR ENGINES, BOILERS, TURBINES, ETC.

SECTION 2.—**HOISTING MACHINERY.**

WINDING ENGINES, HYDRAULIC, STEAM, ELECTRICAL AND HAND CRANES. WINCHES, JACKS AND OTHER LIFTING APPLIANCES.

SECTION 3.—**PUMPING MACHINERY.**

PUMPING ENGINES, CENTRIFUGAL, STEAM, ELECTRICAL AND HAND PUMPS.

SECTION 4.—**MACHINE TOOLS**

AND ACCESSORIES.

FOR WORKING METALS, WOOD, ETC.

SECTION 5.—**CONTRACTORS' PLANT AND RAILWAY MATERIALS**

INCLUDING MACHINERY AND MATERIALS FOR THE CONSTRUCTION AND EQUIPMENT OF RAILWAYS AND OTHER PUBLIC WORKS.

SECTION 6.—**MINING, COLONIAL AND MANUFACTURING MACHINERY.**

FOR TREATING ORES, CORN, COFFEE, RICE, SUGAR, COTTON, AND OTHER PRODUCTS, OIL MILLS, ICE MAKING, DISTILLING, ETC.

SECTION 7.—**USEFUL TABLES AND MEMORANDA.**

FOR ENGINEERS, MERCHANTS, AND MANUFACTURERS.

Each Section, bound in cloth, is sold separately, price 3/6 each.

The subject matter has been entirely re-written, and is illustrated by a large number of Engravings which (for the most part) represent work carried out by the Author's Firm.

The arrangement is intended to be in a handy form for reference, useful alike to engineers, users, and to purchasers of machinery and of materials connected therewith.

The prices are based on the present cost of materials and of labour and these—as well as details of design and proportions—are necessarily subject to modification without notice.

Some data is given with reference to the cost of working, motive power required and work performed; also approximate weights and measurements, so that the results obtainable and the total cost including freight, import duties, &c., may be roughly estimated. The cost of packing for shipment and delivery to docks varies with the nature of the packing required and the destination, the rates given being the average as nearly as they can be determined.

Code Words for each kind of machine will be found in the index, and these, in conjunction with the sentence words in Appleby's Copyright Telegraph Code which precedes the Index, will usually suffice for correspondence by cable; by specifying the price, Fig. No., or page in figures, the leading dimensions of the tool required can be indicated. An example of the mode of using this and other codes will be found at page IV.

PREFACE.

Much information relating to the matters referred to in the following pages will be found in text books, treatises, and trade catalogues, but it is treated, for the most part, in a manner too technical to be of real service to many who—although buyers and users of machinery—may not possess intimate knowledge of details of construction, the cost of machines, their productive capacity, &c.

Conscious, as the Writer is, that the efforts of no single individual will suffice to cover the ground thus left vacant, he has attempted to cover some of it by presenting information with regard to the construction, the approximate prices of the machines described, the probable output, and other data which will serve as a basis for estimating the cost of the machinery and, approximately, the cost of working it.

The arrangement adopted in the first edition of APPLEBY'S HANDBOOK OF MACHINERY, which was published in 1869, has been to a large extent adhered to in this edition, but the advances made in all branches of mechanical construction since that time, have been so incredibly great and varied, that nothing which appeared in the above-named edition, or the numerous reprints of it, have been found suitable for reproduction, so that the descriptive matter has been entirely re-written and—as far as practicable—corrected up to this date.

It is to be regretted that the space available does not admit of more extended reference to some interesting modern developments in engineering construction, and that the illustrations and descriptions must be limited to those which may be regarded as being of general interest.

These remarks are peculiarly applicable to the machinery more especially referred to in this Section, which must frequently be modified to suit local and special conditions. Efficiency and the best commercial results depend so largely on the appliances employed and on the arrangement of plant and buildings, that it is often desirable to obtain advice from an Expert in these branches of construction.

APPLEBY'S COPYRIGHT TELEGRAPHIC CODE

FOR CORRESPONDENCE BY TELEGRAM.

NOTE.—CABLE ADDRESS: "MILLWRIGHT, LONDON."

The code numbers are for use in case a repetition of the telegram may be necessary.

ENQUIRIES AND QUESTIONS.

191290	**Taaier**	..Telegraph how soon you could ship the following, viz.....
191291	**Taaiheid**	..Reply, by letter, how soon you could ship the following, viz.....
121292	**Taainagel**	Telegraph at what price, packed and delivered f.o.b. English port, you could supply and ship the following, viz.....
191293	**Taalboek**	Reply, by letter, at what price, packed and delivered f.o.b. English port, you could supply and ship the following, viz.....
191294	**Taaldeel**	Telegraph how soon and at what price, packed and delivered f.o.b., you could supply and ship the following, viz.....
191295	**Taaleigen**	Reply, by letter, how soon and at what price, packed and delivered f.o.b. English port, you could supply and ship the following, viz.....
191296	**Taalfout**	..Telegraph name of vessel by which you have shipped.
191297	**Taalgebrek**	We learn that the.....with your goods on board has been lost. Shall we replace?
191298	**Taalgids**	..Telegraph, at my expense, how soon my order will be despatched.
191299	**Taalgrond**	..Reply, by letter, how soon my order will be despatched.
191300	**Taalkundig**	..Do you wish us to proceed with order?
191301	**Taalman**	..Will you leave matter to our discretion?
191302	**Taalregel**	..When will remittance be sent for £.....
191303	**Taalschat**	..Send us a complete tracing of.....
191304	**Taalteeken**	..Send us a photograph of.....
191305	**Taalvitter**	..Send us a complete estimate for the following.....
191306	**Taalvriend**	Prepare design and send tracing and estimate including delivery f.o.b. for.....
191307	**Taalwet**	..Can you alter the goods to our order as follows.....
191308	**Taalzifter**	..How soon can you deliver?
191309	**Taanbloem**	..Have you in stock?
191310	**Taartblik**	..A reply by wire is requested.
191311	**Taarten**	..A reply by first mail is requested.

ORDERS AND INSTRUCTIONS

By Sailing Vessel.	Steamer.	Mail Boat.	
191312 **Taartepan**	191313 **Taartjes**	191314 **Taartkoek**	Please supply and ship as soon as possible the following goods, engaging freight and insurance, free of particular average.
191315 **Tababocca**	191316 **Tabacalero**	191317 **Tabacales**	Please supply and ship as soon as possible the following goods, engaging freight and insurance, free of all risks, if latter is possible.

191318	**Tabaccasse**	..No part of the machine must weigh more than.....cwts.	
191319	**Tabacchi**	..We leave matter to your discretion.	
191320	**Tabacomane**	..Preferring them in the order named.	
191321	**Tabacosas**	..Payments will be made by.....	
191322	**Tabacoso**	..Payments will be made by.....	Arrange terms with that firm.
191323	**Tabagie**	..Terms will be as before.	
191324	**Tabagique**	..Remittance is delayed until.....	
191325	**Tabahia**	..Draw on us at sight for £.....	
191326	**Tabakasche**	..Draw on us at.....	
191327	**Tabakbau**	..Await instructions for shipment.	
191328	**Tabakbeize**	..Replace with all possible despatch.	
191329	**Tabakdampf**	..Duplicate our order of.....	
191330	**Tabakkorb**	..Repeat our order for.....	
191331	**Tabakladen**	..Repeat our last order.	
191332	**Tabakqualm**	..Await our letters before proceeding.	

Orders and Instructions—*Continued.*

191333	**Tabakrauch**	..Same pattern or quality as before.
191334	**Tabakreibe**	..The same as you last supplied.
191335	**Tabakrolle**	..Same as supplied by you in.....
191336	**Tabaksblad**	..Same as supplied by.....in.....
191337	**Tabaksbouw**	..Same as supplied to.....in.....
191338	**Tabaksland**	..Draw on us for £.....at the following number of days from sight.
191339	**Tabakspijp**	..Please deliver at once.
191340	**Tabaksrook**	..Please deliver next week.
191341	**Tabakstube**	..Must be inspected by.....
191342	**Tabaksvat**	..Ship at once.
191343	**Tabaksveld**	.....has been irreparably damaged send another.
191344	**Tabakszak**	.....has been lost replace it immediately.
191345	**Tabaleabau**	..Please send by next mail certificate for
191346	**Tabaleara**	.Prepare for delivery at once.
191347	**Tabaleos**	..Wanted for immediate delivery.
191348	**Tabalhiom**	..The makers were (are).....
191349	**Taballiado**	..As described in Appleby's Handbook of Machinery, price £.....
191349	**Tabanidae**	..As illustrated in ,, ,, ,, Fig.....
191349	**Tabanus**	..As described in ,, ,, ,, page.....

ANSWERS, &c.

191350	**Tabanca**	..Freight will add about.....per cent. to the f.o.b. cost.
191351	**Tabanidae**	..The machine will weigh about.....cwts.
191352	**Tabaquear**	..The total weight will be about.....tons.
191353	**Tabaqueiro**	..The total measurement will be about.....cubic feet.
191354	**Tabaqueras**	..No part of the machine will weigh more than.....cwts.
191355	**Tabaqueurs**	..The machine is finished.
191356	**Tabaquista**	We can supply you with goods, as per your enquiry, at the following *net* price.
191357	**Tabardelha**	..Please telegraph credit with some English Bank for order just received.
191358	**Tabarder**	The credit opened with the Bank is too small; please to telegraph further credit for £.....
191359	**Tabardilho**	..We cannot execute order on other terms.
191360	**Tabarzet**	..We have remitted you by letter £.....
191361	**Tabatiere**	..Cash will be paid against Bill of Lading by.....
191362	**Tabaxir**	..Machinery is shipped by steamer.
191363	**Tabbard**	..Machinery will be shipped by steamer.
191364	**Tabbaoth**	..Machinery is shipped by sailing vessel.
191365	**Tabbinet**	..Machinery will be shipped by sailing vessel.
191366	**Tabbying**	..Your order received and has our best attention.
191367	**Tabebuia**	..Remittance follows by mail.
191368	**Tabefatto**	..Remittance will be sent immediately for £.....
191369	**Tabefied**	..Waiting your remittance.
191370	**Tabellaria**	..Credit arranged through.
191371	**Tabellaron**	..Credit arranged by telegraph.
191372	**Tabelle**	..£10 additional needed to cover cost.
191373	**Tabelliar**	..£20 ,, ,, ,,
191374	**Tabellioa**	..£30 ,, ,, ,,
191375	**Tabellions**	..£40 ,, ,, ,,
191376	**Tabellone**	..£50 ,, ,, ,,
191377	**Taberd**	..£60 ,, ,, ,,
191378	**Tabergite**	..£80 ,, ,, ,,
191379	**Tabernacle**	..£100 ,, ,, ,,
191380	**Tabernero**	..£ ,, ,, ,,
191381	**Tabescence**	..We can deliver from stock.
191382	**Tabescent**	.. ,, ,, in one week.
191383	**Tabetique**	.. ,, ,, in two weeks.
191384	**Tabicadas**	.. ,, ,, in three weeks.
191385	**Tabicamos**	.. ,, ,, in four weeks.
191386	**Tabicar**	.. ,, ,, in six weeks.
191387	**Tabicaron**	..The time for delivery should be.....weeks.
191388	**Tabicones**	..The time of delivery is of great importance.
191389	**Tabido**	..All charges will be accounted for.....
191390	**Tabificas**	..All charges will be paid by.....
191391	**Tabiflui**	..I (we) cannot promise delivery until.....
191392	**Tabifluos**	..I (we) cannot promise delivery in the time stated, letter follows.

Answers, &c.—*Continued.*

191393	**Tabiosis** ..	I (we) cannot promise delivery in time stipulated, please telegraph instructions.
191394	**Tabique** ..	..We have not received yours of the.....
191395	**Tabiqueis** ..	..Replying to your telegram, (enquiry) our price is £.....
191396	**Tabiquemos**	Replying to your telegram, our price, subject to prompt confirmation of order, will be £.....
191397	**Tabiser** ..	..Full information follows by mail.
191398	**Tablacho** ..	..Tracing and estimate will be sent.
191399	**Tablabo** ..	..Tracing and estimate were sent.
191400	**Tablajero** ..	..We have received your order for.....

GENERAL MESSAGES.

191401	**Tablares** ..	.....steamer is delayed by having to put in at.....
191402	**Tablazones**	.....is erected and works satisfactorily.
191403	**Tablazos** ..	.....is erected but does not work satisfactorily.
191404	**Tableabais** ..	.....is erected but does not yet work satisfactorily, send immediately by quickest route.
191405	**Tableadas** ..	.....will leave on or about the.....
191406	**Tablearia** ..	.....cannot leave before the.....
191407	**Tablearon** ..	.....is completed.
191408	**Tableaux** ..	..I (we) will see you on or about
191409	**Tableros** ..	..We must have dimensions, sketches, or drawings.
191410	**Tabliers** ..	..We require more detailed information with reference to.....
191411	**Tablilha** ..	..We are sending you additional information with reference to.....
191412	**Tablon** ..	..We last heard from you on the.....
191413	**Tabloza** ..	..Refer to our letter dated.....
191414	**Taboas** ..	..Refer to our telegram dated.....
191415	**Taboinha** ..	..We refer to your letter dated.....
191416	**Tabolagem** ..	..We refer to your telegram dated.....
191417	**Taboleiro** ..	..Have you received our order for.....
191418	**Taboleta** ..	..We have not received your order for.....
191419	**Tabooed** ..	..Please send necessary instructions.
191420	**Taboriten** ..	..Please send confirmation by letter.
191421	**Tabouer** ..	..We forward by steamer advertised to close on the.....
191422	**Tabouret** ..	..Can you forward by the.....
191423	**Tabourine** ..	..The Bill of Lading must be to the order of.....
191424	**Tabraca** ..	..The Bill of Lading must be sent to.....
191425	**Tabrimon** ..	..The Bill of Lading has already been sent to.....
191426	**Tabual** ..	..The Bill of Lading has not been received.
191427	**Tabuda** ..	..Delivery cannot be made until we have the Bill of Lading.
191428	**Tabularize** ..	..Have you received the Bill of Lading.
191429	**Tabulating** ..	..Insure to cover cost, freight and insurance.
191430	**Tabulista** ..	..Insure to cover all charges and risks if latter is possible.
191431	**Taburno** ..	..We accept your order for.....
191432	**Tacahout** ..	..We accept your order dated.....
191433	**Tacamaca** ..	We cannot accept your order on terms proposed, please refer to our offer.
191434	**Tacca** ..	..Forward as early as possible.
191435	**Tachylite** ..	..We accept your offer dated.....
191436	**Tachypetes** ..	..We can carry out your proposals at extra cost of £.....
191437	**Tacitly** ..	.. ,, ,, ,, without extra cost.
191438	**Taciturn** ..	..Details of conditions are sent by mail.

DIMENSIONS, &c

191439	**Tackduty** ..	..The gauge (or span) is.....inches.
191440	**Tackled** ..	..The radius is.....feet.
191441	**Tackling** ..	..The height of lift is.....feet per minute.
191442	**Tacksman** ..	..The speed of lift is.....feet per minute.
191443	**Tackspins** ..	..The maximum load is.....cwts.
191444	**Tactical** ..	..The average load is.....cwts.
191445	**Tadorna** ..	..The machine must take in .....inches.
191446	**Tadpoles** ..	..The output per hour is.....
191447	**Taffata** ..	..The effective horse power is.....

EXAMPLES OF CODE TELEGRAMS.

The following exchange of Telegrams shows the mode in which the Code may be used:—

A correspondent telegraphs "**Taaldeel Facitergio 600**" which, on reference to the Code will be found to translate as follows: "Telegraph how soon and at what price, packed and delivered f.o.b. English port, you could supply and ship the following, viz: 20 head gravitation stamp mill 750 lbs. stamps, price £600."

The reply to this was "**Tabicar Facitergio Tabiquemos 600**" which reads as follows: We can deliver in six weeks 20 head gravitation stamp mill 750 lbs. stamps; replying to your telegram our price, subject to prompt confirmation of order, will be £600."

On receipt of this our correspondent telegraphed: "**Tabacales Facitergio Tabacosas**" which reads: "Please supply and ship as soon as possible by mail steamer the following goods, engaging freight and insurance, free of all risks, if latter is possible, 20 head gravitation stamp mill 750 lbs. stamps; payments will be made by....."

THE A1 TELEGRAPHIC CODE.

The Code words pages i. to viii. conflict, to some extent, with those in the widely used A1 Code, but no confusion can arise if the latter is used *exclusively*, the subjoined (or other agreed) words being employed to clearly identify the Section of the Handbook referred to, thus :—

APPLEBY'S	HANDBOOK	OF	MACHINERY,	SECTION I.	**Admugitum**
,,	,,	,,	,,	II.	**Adnatobat**
,,	,,	,,	,,	III.	**Adociria**
,,	,,	,,	,,	IV.	**Adoliridas**
,,	,,	,,	,,	V.	**Adumbrato**
,,	,,	,,	,,	VI., PART A.	**Adonteremo**
,,	,,	,,	,,	VI., PART B.	**Adopertus**
,,	,,	,,	,,	VII.	**Adoptames**

and the words in the Code which indicate, respectively, the number of page and line referred to, the dimensions of the machine, &c.

Example.—A correspondent who wishes to purchase a diamond prospecting plant—using the A1 Code and the Code word for the Section as above indicated—cables: "**Quersack Duradura Tripaille Adonteremo Trashumar.**"

On reference to the code this message will be found to mean: "What is the present quotation for a diamond boring plant for prospecting, probable depth about 1,600 feet, see Appleby's Handbook of Machinery, Section VI., Part A, page 27."

CONTENTS

AND CODE WORDS FOR USE IN CONJUNCTION WITH APPLEBY'S COPYRIGHT TELEGRAPHIC CODE.

SECTION VI. PART A.

MINING MACHINERY.

MINING MACHINERY.

It is impossible, in the compass of a work of this nature to deal exhaustively with many appliances required for raising and successfully treating all classes of metalliferous ores, and the Author is compelled to limit his remarks to those, in general use, in connection with the more valuable ores containing gold and silver.

This necessarily leaves information in regard to the arrangement and cost of plant for treating the coarser ores, such as copper, tin, lead, iron, coal, &c., to be a subject for correspondence or, by preference, personal consultation. In either case the fullest particulars should be furnished as to the nature of the ore, accompanied (if possible) by specimens, the output required, and the local conditions affecting the plant, transport, etc.

The above named conditions vary so widely that, without such information, it is difficult to give estimates which shall be absolutely reliable, even for the more valuable ores, but the approximate prices of the machinery now given—based on the present value of materials and labour—may be regarded as accurate enough for all practical purposes.

Before describing in detail the various appliances for the reduction of gold and silver ores—referred to in the sequence in which they are generally used—the Author gives some information with regard to mills and machinery, supplied by his firm in recent years, in the hope that it may be useful to engineers, mine owners, etc., and save them loss of time in correspondence or the trouble of selecting the various machines, accessories, spare parts, &c., referred to in the following pages.

SIXTY HEAD GOLD MILLING PLANT (900 lbs. stamps).—The general arrangement of this plant is indicated by the sectional view of mill house, Fig. 6000, from which it will be seen that the frames of the battery are of timber; the machinery and ironwork comprise :—The ore breakers, of which there are three, reduce the ore to cubes of about 1 in. and deliver it on to the grizzly bars which were sent out to cut lengths ready to fix in the timber framing made at destination, 12 cast iron mortar boxes, each carrying 5 heads of stamps, spindles, heads, shoes, dies, tappets and cams for the 60 heads, with camshafts and bearings, driving pulleys for each ten head of stamps, hard wood guides for spindles, jack shaft and fingers for raising them beyond the sweep of the cam when required, water pipes, all bolts and nuts, etc., countershaft with pedestals and gun metal bearings and pulleys with clutches.

Seasoned timber was not obtainable at destination and the foundations, supplied with the mill, consisted of pitch pine logs built up to 30 in. square by 10 ft. long with bolts and straps, for each five head of stamps; the woodwork for the amalgamating tables was made of tongued and grooved pitch pine of sufficient width for each set of 5 head stamps, and planished copper sheets, silver plated upon one side, for covering the tables were supplied. Also 60 sheets of copper $\frac{3}{16}$ in. thich, each 36 in. long by 60 in., and 12 sheets $\frac{3}{8}$ in. thick, 7 in. by 57½ in. for inside plates.

Best double leather belting for driving each 10 head of stamps, the ore breakers, clean up pans and amalgamating barrels were provided, and 5000 ft. of 1¼ in. driving rope for communicating the power from the turbine (referred to hereafter).

Spare parts for the mill were sent as follows, viz.: 3 cast iron heads, 25 pairs of forged steel shoes and dies, 3 cast steel tappets, 6 cast steel cams, and 3 mild steel stamper spindles.

The motive power was derived from a turbine of the Jonval type, 42 in. diameter, designed to develop 300 h.p. with a total fall of 59 ft., and running at a speed of 200 revolutions per minute; it was supplied complete with sluice valve, 135 ft. of 42 in. diameter pipe, made of wrought iron plates $\frac{1}{4}$ in. thick, shafting, and rope driving pulley.

The price of the plant complete as above described, including plate iron shoots, twelve automatic ore feeders, hopper doors and gear, woven steel wire screens, two 36 in. diameter clean-up pans on iron frames, and two cast iron amalgamating barrels, as shewn in Fig. 6000; water-mains, countershafting and pulleys with lubricators, all complete with spare parts was £6880.

The approximate total weight was 230 tons.

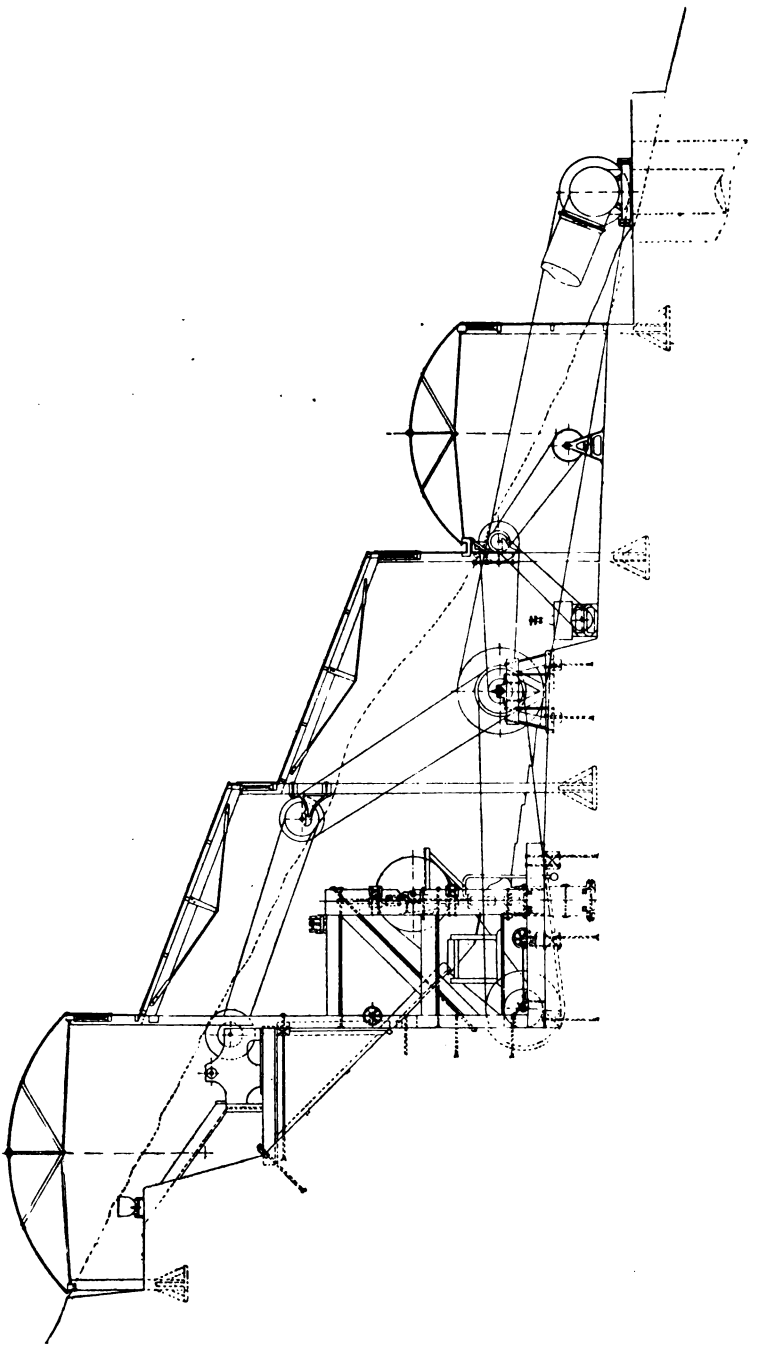


Fig. 6000.

The mill house was a very cheap construction as shewn in the sectional view Fig. 6000, and covered an area of 120 ft. by 76 ft. ; it was equipped with two overhead travelling jennies for a span of 30 ft., with lifting blocks and chains suitable for dealing with loads of 1 ton, a total lift of 15 ft.

The price of the mill house as above described, including the lifting appliances was £849.

The approximate total weight was 41 tons.

An electric lighting installation was supplied with this plant comprising one dynamo for 400 sixteen candle power incandescent lamps, complete with cables, wires, switches, etc., but only 230 sixteen candle power lamps, and the cost was £154.

The approximate weight was 3 tons.

THIRTY HEAD GOLD MILLING PLANT (800 lbs. stamps).—The plant now referred to (not illustrated) consisted of two turbines, two ore breakers, thirty head of stamps with wrought iron framing, six Berdan pans, and all the shafting and gear for transmitting the power from the turbines to the machinery ; the parts throughout were so constructed that no one piece exceeded 30 cwt. in weight.

The two turbines were designed to develop 30 and 20 h.p. respectively when working with 100 ft. head of water, and were complete with adjustable guide blades for varying the power, sluice valves, and the necessary wrought iron pipes—in each case about 100 ft.—in convenient lengths.

The two ore breakers were fitted with cast steel jaws and were of the type illustrated, Fig. 6004, the framing being constructed in wrought iron, so that the limit of weight above referred to should not be exceeded.

The mortars each carried 5 heads of stamps and were made in three sections, the lowest being of hard cast iron, the middle section of heavy wrought iron plates fitting into a seat on the lower section, and lined with steel plates ; the upper section was made of wrought iron, and the 3 sections were firmly secured by strong bolts passing through plates beneath the bottom section. The mill was complete with flanged pipes, stop valves, and the necessary bends and unions, with vulcanized india rubber hose to supply the mortars ; also the shafting to transmit the power from the turbine to the whole of the machinery.

The spare parts consisted of 5 stamp stems, 5 cast iron heads, 50 pairs of forged steel shoes and dies, 6 tappets and 6 cams, 10 per cent. of spare bolts, nuts, rivets and washers for framing, &c., 2 pairs gun metal bearings for camshaft, and two pairs for main shaft.

The amalgamating plant consisted of six Berdan pans as shown in Fig. 6010, and the whole of the machinery was erected and set in motion, as far as possible at the works, before being painted and marked for re-erection at destination.

The iron house for this plant was 60 ft. long in two spans of 30 ft., with wrought iron columns and strong foundation plates ; the offices, retort house, amalgamating room, general office and repairing shop were arranged in a "lean to" from the main building, and were provided with patent wrought iron windows, milled plate glass, &c. The roof was made of galvanized corrugated iron sheets, and was sent out complete with the necessary eaves, gutters, heads, down pipes, &c.

The cost of this specially designed mill as above described, including the tables and riffles, which were made of well seasoned pitch pine, complete with copper plates, also a supply of special long flake scarlet blanketing, also mill house with 3 sets of lifting gear, offices, &c., as stated, was £5276.

The approximate weight, not allowing for measurement was 175 tons.

TWENTY HEAD GOLD MILLING PLANT (700 lbs. stamps), Fig. 6001.—For this installation the stamp mill frames were constructed of wrought iron, and the motive power was supplied from a horizontal steam engine and 3 vertical multitubular boilers.

The mortar boxes were made in sections as described in the specification of the plant last referred to, but this construction should be avoided unless exceptional and strong reasons exist for adopting it, such as the practical impossibility (in some cases) of transporting solid cast iron mortar boxes.

The mill was supplied complete with wrought iron mill house.

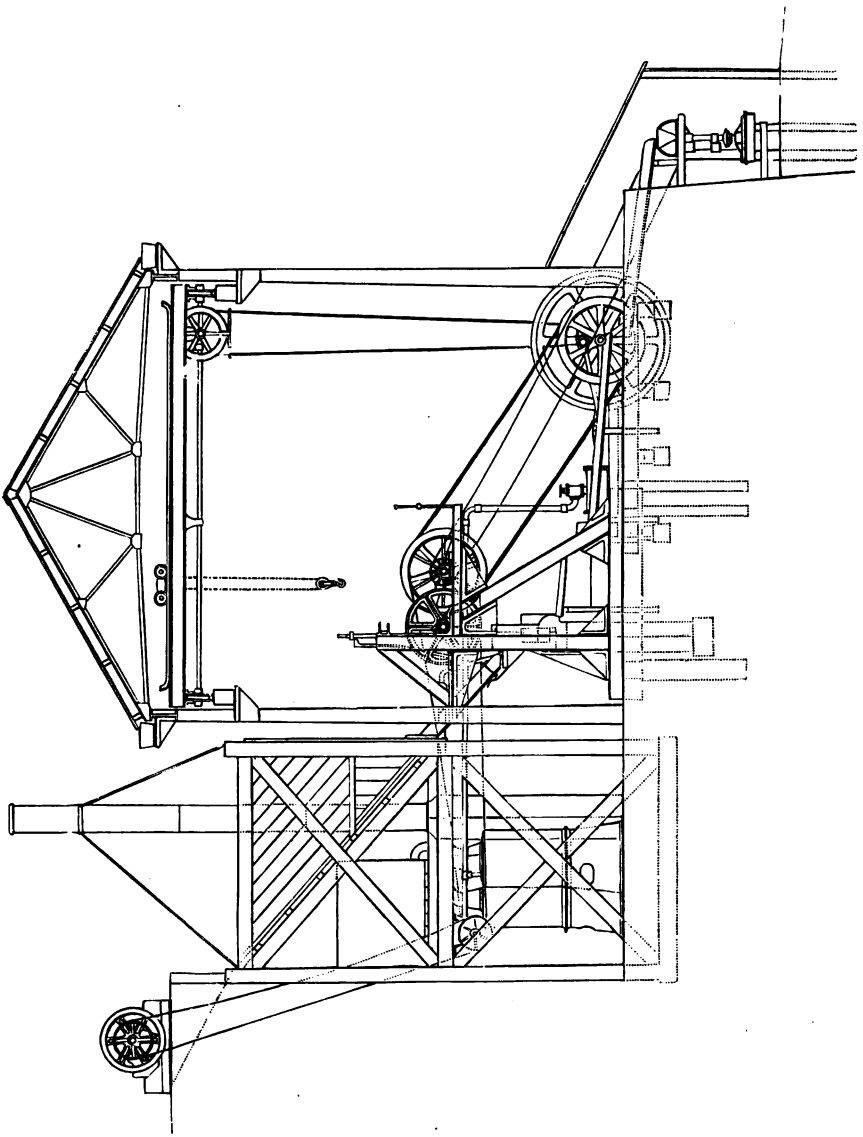


Fig. 6001

The plan, Fig. 6001, shows in sufficient detail the general arrangement of this plant which consisted of, a complete set of elevators with malleable iron buckets and chains capable of lifting 100 tons of ore per day, to a height of 32 ft.; ore breaker with wrought iron frame, steel toggles, and lining plates, as Fig. 6004; four 5 head stamp batteries with wrought iron frames, as Fig. 6006; composite mortars, stamp spindles, heads, steel shoes and dies, tappets, cams and camshafts, countershaft and bearings, rope driving pulley, &c. The amalgamating tables were made of best seasoned pitch pine, planed, tongued and grooved and covered on the surface and sides with sheet copper, patent enamelled riffles with baffleplate, and gun metal screw plugs, blanket strakes, two Gowan's gold savers; a set of 3 throw pumps with stages, &c., for well and special engine for driving same, for providing water supply to the batteries and for domestic use.

The machinery was driven by a horizontal high pressure engine fitted with Porter's governors, Meyers' expansion gear, rope driving wheel, &c., and steam was supplied from three Appleby's patent vertical multitubular boilers as described in Section I., with all mountings, wrought iron chimney and base, and connecting flue to each boiler. The floor was covered with wrought iron chequered plates and the roof was of galvanized corrugated iron.

The dimensions of the mill house were 44 ft. by 25 ft. with a height to eaves of 27 ft. The columns were of wrought iron, box section and strongly braced together, and the wrought iron roof principals were carried on wrought iron girders.

The building was provided with an overhead travelling crane with lifting gear of 3 tons power which commanded all parts of the mill floor. The doors and windows were of wrought iron and the latter were glazed with planed plate glass.

A "lean to" from the mill house provided stores and repairing shop, and another formed offices for clerks and retorting room. Both buildings were constructed of corrugated galvanized iron and were sent out complete with doors, windows, spouting, down pipes, &c. The assay room was provided with the ironwork, fire bricks, retorts, &c., for the furnace, tongs, moulds, and similar appliances.

The spare parts for the mill comprised 10 pairs of forged steel shoes and dies, 5 heads, 5 cams, 10 tappets, a set of gun metal bearings for the cam and countershafts, set of steel liner plates for breaker, toggle plates, a pair of piston rings, eccentric straps, connecting rod brasses, crank shaft bearings, firing tools, gauge glasses, fusible plugs, a supply of best leather belting, hemp driving rope, spanners, oil feeders and 10 per cent. spare bolts, nuts, rivets, &c., for houses and machinery.

The contract included all the necessary tools for fixing the galvanized iron roofs, buildings, and tools for erecting the mill house, as well as an assortment of stores for mill and repairing shop.

The total cost of this plant as above described, including elevators, 20 head mill, motive power, mill house and offices, &c., spare parts as stated, pumps, amalgamating tables, blanket strakes, and all tools for erection, was £4512.

The approximate weight, not allowing for measurement, was 150 tons.

Timber foundations were also sent out for this mill, and all the timber work for elevators, incline hoppers, mill house, lining of amalgamator pit, &c., and the cost of these was about £668.

FIFTEEN HEAD GOLD MILLING PLANT (750 lbs. stamps).—The general arrangement of this plant is not illustrated, but the battery of stamps is similar to that shown in the engraving Fig. 6002; the plant consisted of three 5 head mortars and wrought iron frames, 3 driving pulleys (one for each 5 heads), compound condensing engine of the tandem type with condensor behind the low pressure cylinder, the air pump being worked by a continuation of the piston rod, a feed water heater and 2 Cornish boilers, with extra large furnaces suitable for burning wood; this plant was for working free milling ore and the usual appliances for treating the slimes were not supplied.

The mill was sent out complete with countershaft, pedestals, &c., gun metal bearings and fitted with turned and bored flange couplings, with bolts, and 17 cast iron pulleys varying in diameter from 6 ft. to 1 ft. 10 in. for driving other machines.

The spare parts comprised 6 cast iron heads, hooped, 5 cams, 5 collars, one set of steel liner plates for mortars, 2 planed camshaft brasses, 3 mild steel spindles, and 12 screen plates.

The total cost of this plant was £1570 and the approximate weight, not allowing for measurement, was 52 tons.

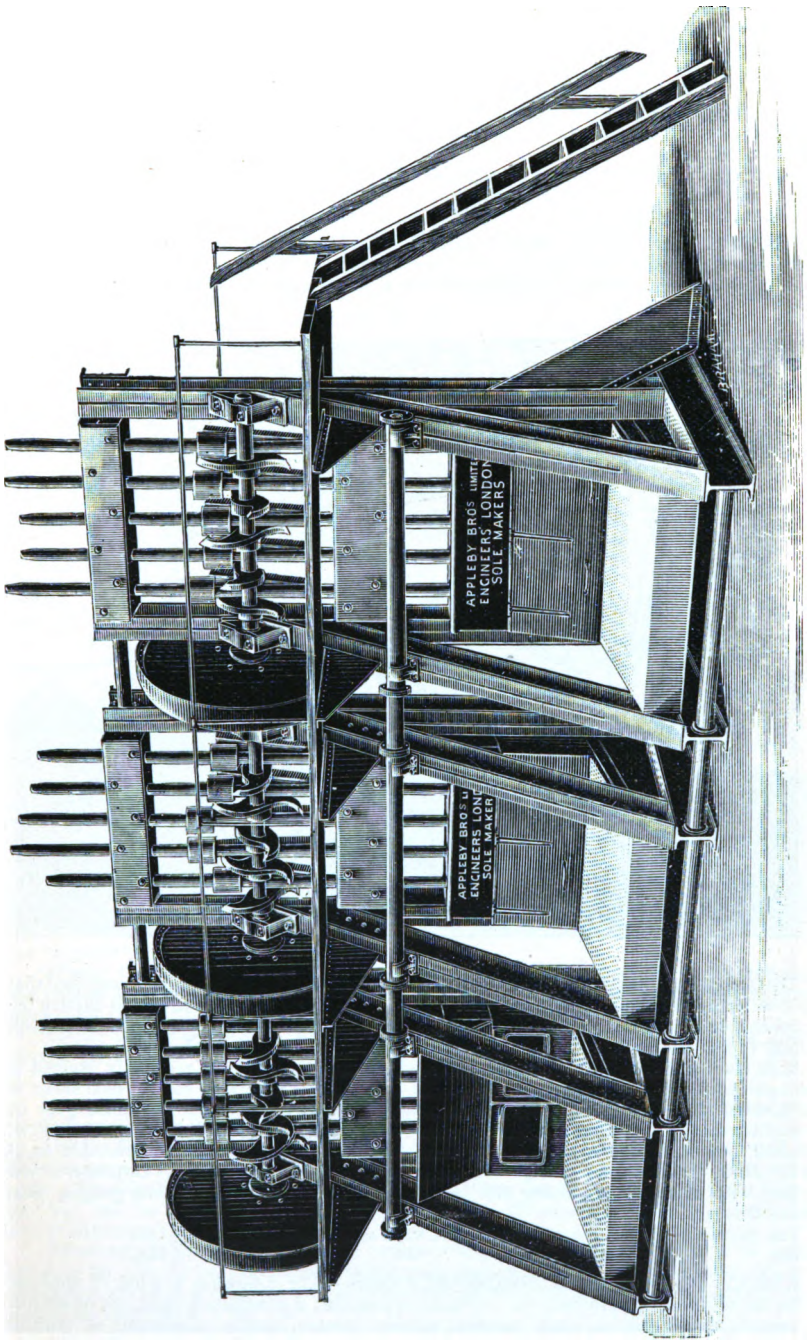


Fig. 6002.

The stores required as a preliminary outfit for a 15 head gold milling plant, are :—15 gallons of cylinder oil, 75 gallons of coal oil, 35 lbs. tallow, 9 boxes of grease, lubricant for cams and guides, solid sheet rubber $\frac{3}{8}$ in. thick, 1 box of candles, 75 lbs. cotton waste, 10 lbs. assorted packing for engine valves, &c., 1 yard $\frac{1}{8}$ in. thick sheet rubber, $\frac{1}{2}$ lb. each sulphuric and nitric acid, 2 oz. metallic sodium, 6 oz. prepared amalgam, 5 flasks of mercury, $\frac{1}{2}$ doz. whisk brooms, 2 sponges, $\frac{1}{2}$ doz. stout chamois leathers for squeezing amalgam, 2 amalgam knives, one stout pestle and mortar. To these should be added 7 lbs. of salammoniac if the amalgamating plates are not silvered.

The prices of miners' tools and mine stores will be found further on under their respective headings and those relating to mechanics' tools, light railway plant, &c., are given in the sections devoted to "Machine Tools" and "Contractors Plant."

PROSPECTORS' GOLD MILLING PLANTS (200 lbs. stamps) are made with 3 or 5 heads of stamps and to work by hand power, as shown in Fig. 6003, or by cattle, engine, or other motive power. These mills are as referred to below and fully described under Fig. 6007.

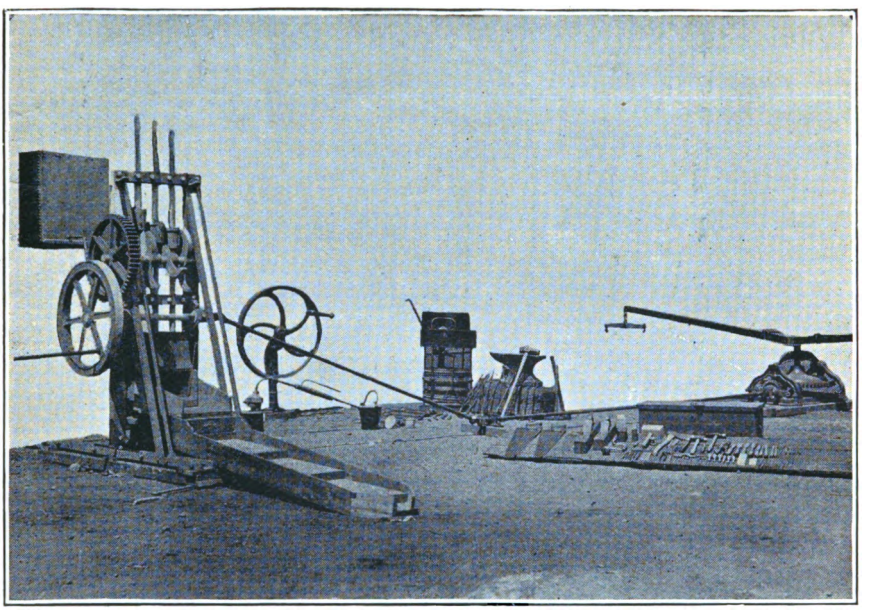


Fig. 6003.

The prospecting party for whom the plant (illustrated Fig. 6003) was made, required that it should be worked by hand or by mule power, at pleasure. It was to make actual battery tests, at considerable distances from the camp and—for this purpose—it was equipped with tables, retorting appliances, tools, &c., as shown in the engraving and specified below.

Both the 3 and the 5 head mills have wrought iron frames, which are easily erected and taken apart for transport, and are complete with cast iron mortar box, forged steel shoes and dies, screens, silver plated copper amalgamating tables and riffles as shown, horse gear with intermediate motion, amalgamator, retort with water jacketed sleeve, mercury bucket with enamelled iron flask, and a useful assortment of smith's tools, including a portable smith's hearth, anvil, smith's and sledge hammers and accessories, also a carpenter's chest equipped with saws, planes, brace and bits, mallet, axe, hammers, chisels, gouges, pliers, gimlets, etc., etc.

The price of the 3 head prospectors' plant such as above described is £150.
Do. 5 head do. do. do. £185.

ASSAY PLANT FOR PROSPECTORS.—The following is a list of appliances suitable for prospecting purposes, viz. :—Pestle and mortar, 6 prospecting pans, set of scarifiers and roasting dishes, scales, assay balance, melting furnace, muffle, assortment of crucibles, cupel, mould and die, parting flasks, set of sieves 40-100 to linear inch, porcelain dishes, pure

silver, assay lead in sheet and granulated, nitric acid, wheat flour or charcoal powder, carbonate of soda, bone ash, borax, nitre litharge, test tubes, and spirit lamp. The price of such an outfit is £42, or with an additional supply of re-agents, crucibles, flasks, dishes, &c. £49 10 0.

The machinery referred to in the foregoing pages has been used exclusively for the reduction of gold ores; and the machinery employed for the crushing and amalgamation of silver ores is so similar in character, that a special description is perhaps scarcely necessary, but the following is a description of a usual type of silver milling plant when used on free milling silver ores which are now rarely found.

TEN HEAD SILVER MILLING PLANT, (not illustrated).—This consists of 1 ore breaker with duplicate set of jaws, grizzly bars and 2 automatic feeders; 1 10-head mill with 850 lbs. stamps complete with wrought iron frames; 2 cast iron mortar boxes with planed bottoms; hard wood framing for screens and wrought iron keys for same; 4 charcoal iron slotted screens, spindles, tappets, cams, camshaft, with shoes and dies for 10 head of stamps; compound wood pulleys for driving the mill; all holding down bolts and washers; also 2 pieces of sheet India Rubber for insertion under the mortar boxes; water mains and pipes to lead the water to each battery box, including all valves and fittings; 4 amalgamating pans and 2 settlers similar to those referred to at Fig. 6009; 1 cleaning up pan 4 ft. diameter. The retorting plant consisting of retort with lid, fastenings and syphon pipe with water jacketed sleeve; all the ironwork for furnace, chimney for same with base plate and guys; iron for flooring complete with holes punched and countersunk for wood screws; 2 pairs of crucible tongs, and 6 crucibles with lids; 3 bullion moulds with marks cast at the bottom, and a set of dishes for amalgam. One overhead crane to lift 3 tons and having a span of about 30 ft., provided with differential pulley blocks, was also supplied for the mill house, as well as the countershafting, pulleys, belting and tighteners for same, and pipes with cocks and fittings for leading water to the pans and settlers.

Water power would of course be preferable for driving the mill but the plant above referred to was driven by a horizontal high pressure steam engine of the type illustrated in Fig. 1507 of Section I., and 2 vertical multitubular boilers as illustrated, Fig. 1529 of the same section, were supplied. The approximate cost of this mill which had a capacity of from 18 to 20 tons per 24 hours was £2750. The cost of the building may be roughly estimated at 2/- per square foot of area covered.

SILVER ORES, NOT FREE MILLING, as is the case with most, are treated either by the smelting, or by a wet process.

The former is generally applicable to all sulphide ores that contain considerable quantities of galena, or other lead ores, or to cupriferous silver ores. Ores rich in zinc or which (for any other reason), are not suitable for smelting, are treated by a lixivation process.

Lixivation as now carried out, is a modification of the old Augustine method whatever may be the process adopted, one of the most favoured being the Russell.

The method consists (generally speaking) of a chlorodising roasting in Bruckner cylinders, Stetefeldt, Howell, or the ordinary reverberatory, furnace, the chloride of silver thus formed being leached out in tanks by some suitable chemical, such as a solution of hyposulphite of soda; the dissolved silver is recovered from the precipitating tanks.

The plant therefore consists of Rockbreaker, dry crushing plant—for which either rolls or dry crushing stamps specially arranged for this purpose and fitted with fans to draw out the crushed ore, are suitable—the furnace and a series of tanks with their connections and pumps. This is essentially a chemical process in which mechanical engineering plays a subordinate part to chemistry.

Water Jacket Furnace.—For the smelting process which produces, in the first instance base bullion that requires refining, the principal part which the mechanical engineer has to make is the water jacket furnace, with its accessories.

Ample data is required as a basis for designs and estimates for plant of the kind now referred to.

Having now described some complete installations, the author proposes to deal with the machines referred to therein in detail :—

ORE BREAKERS, Fig. 6004.—This machine is a modification of the well known Blake's system inasmuch as the framing is, as far as possible, constructed of steel plates and angles; by this means the weight of the heaviest piece can be limited, if necessary, to about 300 lbs. and so greatly reduce the cost and the difficulties frequently experienced, in land transport.

Wherever practicable however, the ordinary massive cast iron framing is to be preferred, not only on account of the smaller initial cost, but on account of the greater rigidity and consequent efficiency; crushers with built up frames should therefore only be employed in cases of absolute necessity.

The capacity of the machines varies of course according to the nature of the ore, and the duty stated in the subjoined price list is the capacity of the machine when working on typical quartz, the flywheel making 200 to 300 revolutions per minute.

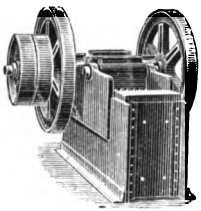


Fig. 6004.

The parts throughout are of ample proportions for the severe strains to which these machines are subjected, and special provision is made for replacing parts most liable to wear, with the least possible delay; to reduce this wear as much as possible, the jaws (which are reversible) and the toggle plates are made of specially hard and strong metal.

The following list gives the standard sizes for these machines; larger machines are made but are not recommended, because experience indicates that it is better to use two or more smaller machines. The usual practise is to supply one ore breaker with jaws 12 in. by 8in. for each 10 head of stamps or the equivalent.

PRICES OF ORE BREAKERS, Fig. 6004.

Size of opening .. .. .. inches	10 by 8	12 by 8	15 by 10	18 by 10	20 by 10
Approximate output per hour .. tons	3	5	7	8	9
Nominal H.P. required to drive	3	4	5	7	8
Price with cast iron frames	£90	£95	£125	£135	£150
Do. wrought steel frames	£175	£205	£240	£270	£300
Approximate weight .. .. tons	3½	4	240	6	7

Packing for shipment and delivery f.o.b. costs 5 per cent.

GYRATORY ORE BREAKERS (not illustrated) are made in all sizes but are found to be most satisfactory in cases where a large output is required, and it is better to use the large crushers than a number of small ones to give the necessary output; a saving will however be effected if a large quantity of ore has to be crushed, to cubes of say ¾ in., by having two crushers, the quartz being reduced by the first crusher to such a size that it passes through the grizzly screen, or is carried on to the second crusher which rapidly reduces it to the desired size; wet or sticky ores are more satisfactorily treated in the ordinary ore breakers last referred to.

The machine consists of a cylindrical casting within which a set of dies are fitted, forming a jaw of the shape of a truncated cone pointing downwards: this is partly closed by the gyrating head that forms the moving jaw, and which carries a die in the form of a cone pointing upwards; the crushing head is carried on a shaft slightly inclined from the vertical, so arranged as not to revolve, but only to receive the gyratory motion of the shaft.

The advantages of this ore breaker are, that the power required to drive is considerably less for any given output than that required for the machine Fig. 6004, and there is less jar upon the floor of the ore breaker house; on the other hand the machine is rather more complicated, and the great weight of the framework is a drawback not easily overcome; for dealing with large quantities of quartz it is however undoubtedly to be preferred, and the recent practice of crushing at the mine head makes the great weight less objectional: moreover it has been found that with these machines the use of grizzly screens is hardly necessary.

PRICES OF GYRATORY ORE BREAKERS.

Size of 3 openings, each inches	12 by 5	14 by 6	15 by 7	18 by 8	20 by 10	24 by 11	30 by 13
Approx. output per hour tons	6	9	15	20	30	40	55
Nom. H.P. required to drive..	4	6	12	18	25	30	35
Number of revolutions ..	475	450	425	400	375	350	350
Price	£130	£175	£265	£420	£525	£755	£1100
Approximate weight .. tons	2½	3½	6	9	12	16	27

Packing for shipment and delivery f.o.b. costs 5 per cent.

GRIZZLY BARS OR ORE SCREENS.—The bars for these are made of a special section cast steel, about 10 ft. long, and are set in a timber frame (usually made at destination) about 4 ft. wide; they are spaced from 1 in. to 2 in. apart according to the size of cubes required and the nature of the ore. The broken ore is taken by shoots to the stamper boxes, or now, more generally, to automatic feeders as described on the following page.

The price of a set of two screens suitable for a 10 head battery, with bars set in timber frame as above described is £32 15 0 each.

If without timber frame, £24 10 0.

And for larger batteries the cost of suitable ore screens can be approximately estimated by multiplying this figure in proportion with the larger area required.

AUTOMATIC ORE FEEDERS.—The importance of a steady and regular delivery of ore into the mortar boxes is now so generally recognised, that the old system of feeding by hand is seldom employed. Various appliances have been devised for this purpose, and that under consideration consists of an arrangement whereby the quantity of ore delivered into the mortar is regulated by an attachment between the feeder plate and one of the stamp stems. This regulates the feed most effectually, because if the supply of ore is momentarily too large, the spindle does not fall its full height; the effect of this is, that the mouth of the feeder tray remains practically closed until the excess of ore in the stamper box has been crushed and discharged, on the other hand, when the spindle falls its full height the motion of the lever attached to the feeder, opens it to the full extent and so maintains a perfect supply of ore.

It has been found that automatic ore feeders as above described increase the capacity of a mill quite 15 per cent by keeping up a steady supply of ore to the mortar boxes, and as the die is always kept covered with a bed of ore, the wear and tear of shoes and dies is much less.

The power required to drive these feeders is so little that it can be neglected, and two machines will enable the services of a man, whose duty it would have been to feed two 5 head batteries, to be dispensed with.

One feeder is required for each 5 head of stamps and the cost with the necessary attachment to stamp spindle, is £28.

Approximate weight 6 cwt.

ORE CRUSHING MACHINERY.—Amongst the numerous systems for pulverizing quartz—many of which have distinct merits—the stamp mill continues the most popular, and it certainly has the merit of being the most simple in construction and certain in results, for a stamp mill is never placed entirely *hors de combat* if any part fails, as is the case with most of the roller crushers and rotating ore mills; it is not however, within the scope of this work to discuss the merits of the different machines, but simply to describe and give approximate ideas as to cost.

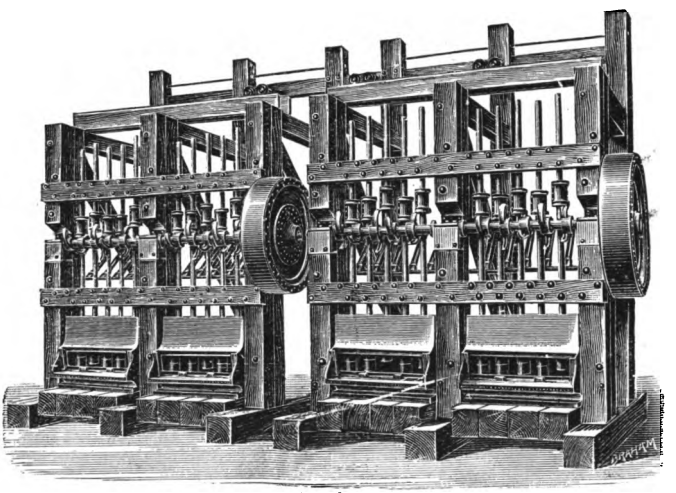


Fig. 6005.

GRAVITATION STAMP MILLS.—Figs. 6005 and 6006 represent gravitation mills of the most modern construction, with timber framing and with wrought iron framing respectively, the outcome of a system devised centuries ago for pulverising ores in Saxony and Hungary. These mills are usually supplied with batteries of 5 head in a box, and if we take as an example, a 10 head stamp battery, the ironwork, exclusive of the frames, will consist of the following parts, viz:—10 stamp stems of best wrought iron or planished cold rolled steel turned taper at both ends, with a cast steel tappet keyed to each with gib and cross keys; also with cast iron heads bored to fit the taper ends of spindle, and forged steel stamp shoes

with taper shank to fit in a corresponding taper hole in the head; 10 forged steel dies to fit the two cast iron mortar boxes; these are now usually fitted with steel liner plates to protect the inner walls of mortars, charcoal iron, or woven wire screen mounted in pitch-pine frames, and keys for holding same in position; two sets of upper and lower hard wood guides for stamps, with bolts; and two shafts complete with brackets for carrying the 10 hard wood levers for suspending the stamp stems beyond the stroke of the cams when required; two bright forged steel camshafts with ten cast steel cams keyed thereto; also 3 heavy brass bearings for the camshaft with loose caps and lock-nuts; two composite wood and iron pulleys for camshaft with key ways cut, turned on face and complete with forged steel keys; watermains with cocks and all connections necessary for leading water to the battery boxes; all the ironwork for the framing including bolts, nuts and washers, with 10 per cent spare.

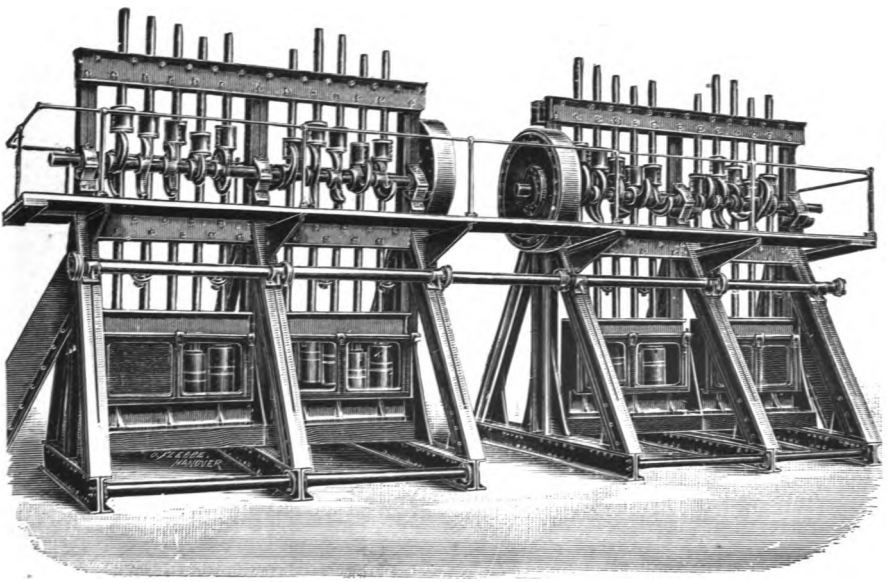


Fig. 6006.

The framing of these mills is either made in best selected timber, usually pitch pine, as shown Fig. 6005, or of mild steel of channel and other suitable sections as shown, Fig. 6006, but where timber is plentiful in the locality in which the mill is to work, the frames are almost invariably prepared by purchasers at destination, in accordance with drawings supplied for this purpose. The framing is also made in cast iron in some cases, and the prices of such mills are rather less than those given below; for ease of transport and greater resiliency such frames are preferred by eminent mining engineers.

The falling weight of the stamp necessarily affects the price of the mill, because the heavier the falling weight, the stronger the frames must be; the weights usually preferred by mining engineers vary from 750 to 1200 lbs. per head—excepting of course in the case of prospecting mills—according to the density of the ore to be treated, and the following list gives the approximate prices and weights of mills in general use, and of their accessories.

For suitable engines and boilers, turbines and water wheels, see prime movers, Section I.

For driving belts, pulleys, countershafting, bearings, etc., see Section IV.

PRICES OF GRAVITATION STAMP MILLS, Figs. 6005 and 6006.

Number of stamps	5	10	15	20	30
Approximate nominal H.P. required	10	20	30	40	50
Ditto output per 24 hours .. tons	10-17	20-35	30-50	40-70	70-120
Price of Ironwork only, Fig. 6005, 750lbs. stamps	£215	£405	£600	£740	£1140
Ditto do. do. do. 850 do.	£220	£418	£616	£770	£1170
Ditto do. do. do. 950 do.	£245	£435	£650	£818	£1235
Approximate weight do. do. .. tons	8	16	24	32	48
Price of timber frame mill complete, Fig. 6005, 750lbs. stamps	£228	£440	£660	£845	£1250
Ditto do. do. 850 do.	£245	£468	£692	£896	£1335
Ditto do. do. 950 do.	£270	£492	£730	£943	£1395
Approximate weight do. .. tons	9	18	27	32	54
Price of iron frame mill complete, Fig. 6006, 750lbs. stamps	£327	£618	£716	£1135	£1365
Ditto do. do. 850 do.	£344	£642	£963	£1240	£1840
Ditto do. do. 950 do.	£363	£785	£1040	£1385	£1995
Approximate weight do. .. tons	12	24	35	48	70
Timber foundations for mortar box	£38	£76	£114	£142	£228
Extra if mortar boxes are sectional	£28	£56	£84	£112	£168

APPROXIMATE PRICES OF SPARE PARTS AND ACCESSORIES FOR ABOVE.

Spare mortar boxes, machined .. .. each	£40 to £55
Liner plates for ditto	£5 to £8
Spare stems .. .. each	£4 to £5 10
,, tappets with gib keys .. .. ,,	£3 to £4
,, camshaft .. .. ,,	£15 to £20
,, cams .. .. ,,	£3 10 to £5 10
,, camshaft brasses .. .. ,,	£3 to £4 10
,, cast iron heads .. .. ,,	£5 to £6 15
,, forged steel shoes .. .. per cwt.	26/-
,, forged steel dies ,, ... ,,	28/-
Copper plate tables, 10 ft. long, 5 ft. wide .. .. .. per set	£15
Copper plates, ⅛ in. thick .. .. per sq. ft.	8/-
Extra for electro-silvering per oz. .. .. .. ,,	10/6
Mercury riffles in timber .. .. each	£4 10
Do. do. in enamelled iron see page .. .. .. ,,	£5
Charcoal iron screens perforated .. .. per sq. ft.	2/10
Do. do. slotted .. .. ,,	2/6
Woven wire screens, per sq. ft. .. .. ,,	1/-
Deal frames for do. .. .. each	30/-
Blanket strakes, 16 ft. long, 6 ft. wide .. .. per set	£10 15
Countershafting per 5 head battery	£22
Composite timber and iron driving pulleys, 5 ft. diameter, 10 in. face	£35
Belt tighteners .. .. each	£9 10

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

DREDGING FOR GOLD.—For description and cost of appliances for this purpose, in use under widely differing conditions, with and without amalgamating plant, &c., see "Dredging Machinery," Section V. The leading particulars required are: the nature and quantity of deposit to be raised in a given time and the maximum depth, also whether the plant is to be complete with pontoon, engine, boiler, &c.; in which case full details as to draft, fuel, &c., should be given.

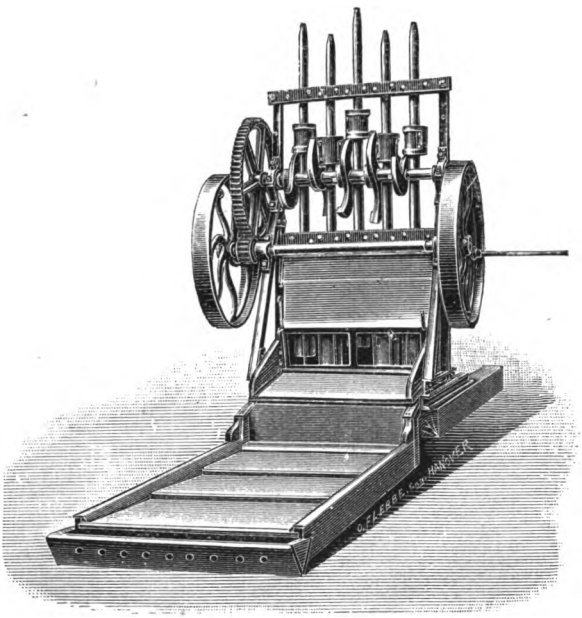


Fig. 6007.

PROSPECTORS STAMP MILLS, Fig. 6007.—These mills are made in batteries of 5 head and 3 head of stamps, (Fig. 6003), and to work by hand power, mule gear, or other motor; they are however specially designed to be easily transported and re-erected, and for the wrought iron framing to be easily taken down and removed. The falling weight of each stamp is, usually 200 lbs.; this consists of spindle, head and shoe and die, and and the only heavy piece is the mortar box which can be made of cast steel, or in sections, if necessary, to reduce the weight of each part.

The cost of a complete prospectors' plant is given under Fig. 6003, and below will be found prices of these mills separately.

PRICES OF PROSPECTORS' HAND STAMP MILLS, Figs. 6003 and 6007.

Number of heads	3	5
Price of hand power mill	£65	£105
Approximate weight do. .. .. tons	2	3½
Price of horse gear with intermediate motion	£20	£28
Approximate weight do. do. .. .. .. tons	1	1½

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

QUARTZ CRUSHING ROLLS are theoretically the most economical form of fine crusher, as their action is continuous and they do effective work in proportion to the power absorbed, instead of the intermittent work found in a stamp mill; they are really an improvement upon the old Cornish rolls, but have not, up to the present been satisfactorily adapted for wet crushing, which appears to be the only reason for their not being more generally employed.

The rolls are carried in strong frames and are provided with fast and loose pulleys for driving by belt through pulleys keyed on the roll spindles, and are kept up to their work by strong India rubber springs which furnish the necessary elasticity; these rolls receive almost as rough treatment as the stone breakers, and the details of the machines now described, have been specially designed to withstand the great wear and tear to which they are subjected. The frame work is secured to iron girders by bolts with lock-nuts, and outside bearings for the shaft carrying the spur wheel are provided.

These rolls cannot be advantageously used to pulverize quartz to a finer grade than 30 mesh and should not be adopted where fine milling is required.

PRICES OF QUARTZ CRUSHING ROLLS.

Diameter of rolls .. .. inches	20	24	30
Length of do. .. .. ,,	12	15	18
Revolutions per minute	16	14	12
Output per hour .. .. tons	3	5	6
Price	£70	£115	£142
Approximate weight .. .. tons	4	5	6

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

HIGH SPEED ROLLS are a further improvement on the system above referred to, and the advantages claimed are :—Economy in prime cost, simplicity in working parts, great efficiency, fewness of wearing parts and general simplicity in design. Obviously the capacity of any machines for crushing ore is dependent upon the amount of crushing surface brought in contact with the ore at a given time, and that cost of crushing is largely affected by the power consumed, and the expense of maintaining the machine in working condition. In this machine the power is effective throughout the operation, none being wasted in raising the falling weights, as in the case of a stamp mill.

The machine consists of a massive bed plate carrying two forged steel rolls about 2½ in. thick, shrunk on to cast iron bosses which are keyed upon large mild steel axles ; the rolls are about 26 in. diameter and 24 in. wide and are driven by belt, direct from the engine or countershaft, the pulley being keyed on the roll spindles.

The usual speed for these rolls is 100 revolutions per minute, and they are kept in contact by springs which are adjustable according to the degree of fineness to which it is required to reduce the ore.

The machine occupies a space of about 7 ft. square and the rollers are covered with a framing which minimizes the escape of dust.

The output from these rolls is about 150 tons in 24 hours through a 16 in. screen, and the average output of a stamp mill being about 2 tons per stamp per 24 hours, the yield from the rolls above referred to about equals that of a 60 head stamp mill, and the power required to drive the rolls is very much less.

The price of a set of rolls complete as above described is £165.

Approximate weight 6 tons.

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

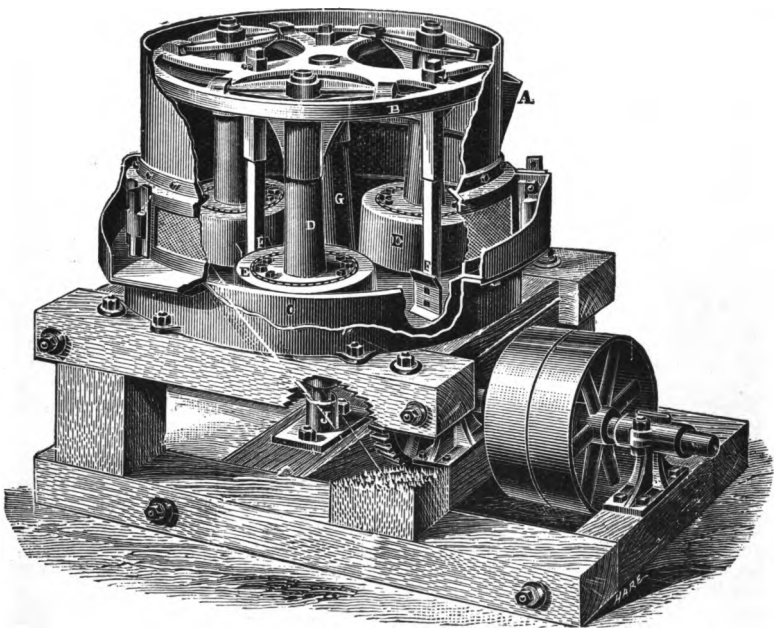


Fig. 6008.

THE HUNTINGDON MILL, Fig. 6008, is used principally for wet crushing, and the inventor claims for it the undernamed important advantages :—That the crushing power is one half more than a stamp mill of equal cost. That all the parts are light and easily transported and erected. That the power required to drive it does not exceed that of rolls ; that the wearing parts are easily replaced ; that it is a perfect amalgamator and does not "flour" the mercury.

The machine consists of a strong iron frame carrying three vertical shafts, each of which has a roller free to revolve at the lower end, and working against a steel wearing rung below the screens; the whole is surrounded by an iron casing with hopper to receive the ore and screens through which it passes to the tables when pulverized.

The frame, from which the rollers are suspended, is set in revolution by gear below the casing and the centrifugal action thus set up, rapidly reduces the ore to the fineness required for it to pass through the screens to the amalgamating tables and, finally, for treatment by vanners or other concentrators suitable for the ore, as in stamp mills.

The rollers do not reach to the bottom of the casing or pan and this space—in which there is some motion but no disturbance—admits of the use of mercury and the production of amalgam under the most favourable conditions for concentration.

These mills, as usually made, are 5 ft. diameter and are driven at a speed of about 70 revolutions per minute.

The driving power required is about 6 horse.

An automatic ore feeder is absolutely necessary with these mills, and the cost of same is £45.

PRICES OF HUNTINGDON MILLS, Fig. 6008.

Diameter of pan	3½ ft.	5 ft.	6 ft.
Output per day .. .. tons	12	20	30
H.P. required	4	6	8
Price	£177	£313	£469
Spare set of Manganese steel rings	£26	£29	£33
Approximate weight .. .. tons	3½	5½	9

Amongst the numerous other machines devised for pulverizing quartz may be mentioned the "Marsden" pulverizer, the "Globe" mill and the "Gruson-Ball" mill, but space does not permit of these being described in detail. Whatever system may be adopted—whether it is a stamp mill or one or other of the machines above referred to—the pulverized ore is delivered through perforated charcoal iron, or woven wire screens fixed in suitable frames; it is then passed through mercury riffles and distributed over amalgamating tables, generally constructed of pitch pine in 3 steps, covered with planished copper plates, the uppermost or all the plates being frequently plated with silver. The crushed ore, after being carried over the amalgamating tables by a sufficient supply of water, is caused to traverse a series of blanket strakes which are covered with specially prepared blankets, to arrest particles of bullion which would, otherwise, pass away with the tailings.

The prices of these accessories are given in the list at page 12, relating to gravitation stamp mills but they apply equally to the other mills to which reference has been made.

OUTPUT OF STAMP MILLS.—This necessarily varies in proportion with the weight of stamps and the hardness or tenacity of the ore operated upon. But data carefully compiled during a long period of working, shows that a mill with stamps weighing 750 lbs. each, pulverize about 2½ cwt. (280 lbs.) of tenacious quartz, per hour, for each indicated horse power employed. Or, say 2¼ to 3 tons of quartz is pulverized per day, for each indicated horse power. Expressed in tons per head per 24 hours, the average of the Rand mills is 3.7 tons per 24 hours and runs up to 5 tons with 1000 lbs. stamps.

WEAR OF SHOES AND DIES.—The character of the ore operated upon naturally affects the question of wear and tear, but a lengthened series of tests, during which shoes and dies were used, made of many qualities of chilled cast iron, steel castings and of steel forgings, pulverizing ores of almost all kinds, have abundantly shown that the special steel forgings referred to below, give by far the best all round results.

The wear and tear of stamp mill shoes and dies, made of this special steel, when working very tenacious gold quartz, was 1.7 lbs per ton of ore pulverized.

In the "Huntingdon" mill, when working the same ore, the wear varies from 1½ to 2 lbs or each ton pulverized.

SHOES AND DIES are subject to such excessive wear, and their renewal forms so large an item in the cost of maintenance, that it is scarcely necessary to mention the false economy of using a low grade of metal, or one not entirely suitable for the purpose.

This fact was brought so prominently before the writer during his examinations of mines and mills in the United States, the Colonies, India, &c., that he thought it desirable closely to investigate the subject, with a view of determining what character of metal would give **the best results in tons of ore pulverized.**

After a series of carefully conducted tests had been made with cast and forged shoes and dies of various qualities of metal, some of which were too hard, others too soft and so forth, one quality was found which, when forged, gave uniform results in the terms above named, irrespective of shape or weight.

This was adopted as the standard quality, and it then only remained to make the special tools required to produce stamp heads with shanks concentric with the body, and all the forgings uniform in shape.

APPLEBY'S SPECIAL STEEL SHOES AND DIES.—The standard quality above referred to is maintained by carefully analysing the steel used for each batch of forgings; the tools for making them being registered and stored, orders by cable are promptly executed, without risk of deviation from what has previously been supplied; as evidence of this orders are frequently received in A B C or private code, or simply the words **"Send—shoes—dies."**

The results of tests made from time to time to ascertain the value of these shoes and dies, as compared with steel castings of various qualities, have always been largely in favour of the special steel forgings, and purchasers, who have ever used them, specifically demand the same quality for renewals.

The prices are regulated to some extent by the shape and weight of the forgings, and special quotations will be given (if required) on receipt of dimensioned sketches. But the best way of ascertaining the value of these shoes and dies, is to have a sufficient number to test them against others and, owing to the facilities afforded by the special tools above referred to, it will be found that the prices are very little in excess of those charged for shoes and dies of the ordinary kind —where large quantities are required, the price is frequently less.

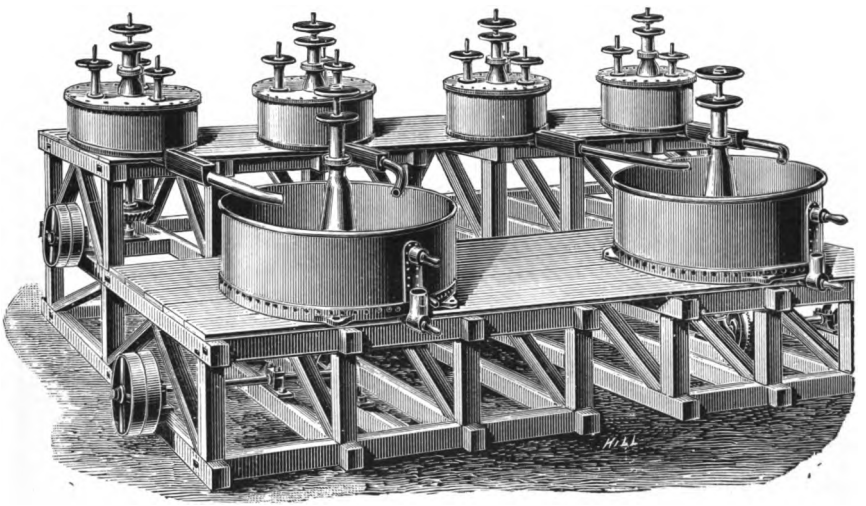


Fig. 6009.

AMALGAMATING AND SETTLING PANS, Fig. 6009.—In some mills, the heavy concentrates from the blanket strakes and concentrators are passed through amalgamating pans and finely ground in contact with mercury thus extracting any free gold that may remain. After this the tailings are led by gravitation into a larger pan where they are allowed to settle, the quicksilver and amalgam being thus separated from the valueless slimes. Two amalgamating and one settling pan are usually provided for each 10 heads of stamps.

THE AMALGAMATING PAN is made of cast iron, about 5 ft. diameter, and is revolved by gear below the pan. The bottom of the pan is lined with hard cast iron plates and above these are a set of mullers which are suspended by spindles rising from the bottom of the pan. These mullers have hard cast iron shoes which, as well as the above named lining plates are easily replaced, when worn.

The position of the mullers is regulated by hand wheels and screws, as shown, for adjusting the distance between them and the floor of the pan, for mixing or for grinding, and complete amalgamation.

The bottom of the pan and the central cone have steam chambers so that they may be heated to the degree required to intensify the process of amalgamation.

THE SETTLING PAN is driven in the manner above described and is usually about 8 ft. diameter and 3 ft. high, but the mullers are of timber adjustable by means of screws and hand wheel, and the bottom is grooved around its circumference, the grooves increasing in depth towards the front where a syphon tap is provided for emptying the pan.

Pans to fulfil both the conditions just described are sometimes constructed with cast iron bottoms and timber staves with wrought iron hoop to bind them together, but this system is not recommended unless necessary for ease of transport.

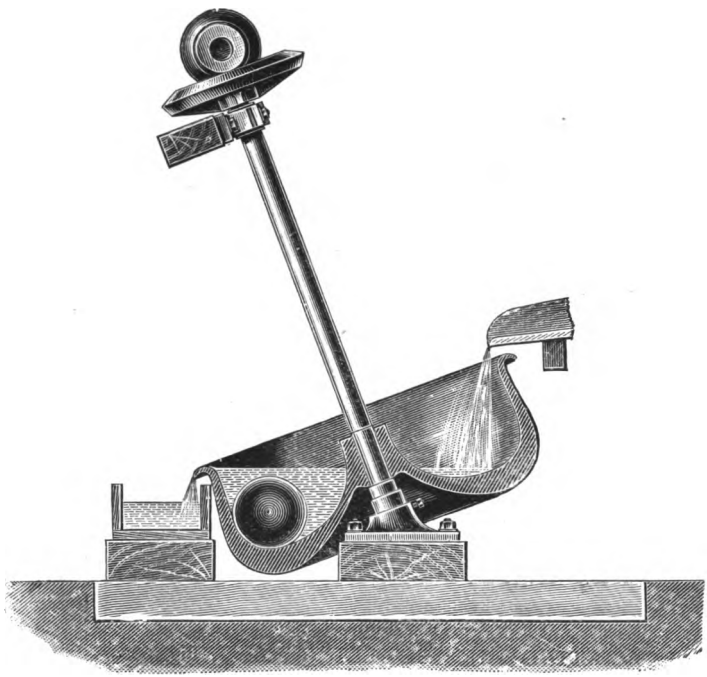
Each set of 3 pans will deal with about 2½ tons per hour and the price per set is £300.

Or for a similar set with wood staves £260.

The pans should make about 65 revolutions per minute and the settlers about 12 revolutions.

The weight per set in iron is 9 tons, and about 14 horse power (actual) is required to drive each set.

The pans can be made in sections if necessary, at an extra cost of about 10 per cent.



Fig, 6010.

BERDAN PANS are made of hard close grained cast iron and are about 4 ft. diameter. The pan is secured to a vertical spindle as shewn in Fig. 6010, and is made to revolve at an angle with the floor level, by arranging the socket in which the toe of the spindle revolves, to suit that angle, the upper end of the spindle is driven by bevil gearing. Heavy cast iron balls are placed in the pan which being rotated rapidly, produces a grinding and amalgamating action; the concentrates are fed on the upper side of the pan and the overflow into a trough at the lower side; each pan will deal with the output from 5 head of stamps.

The price of these pans including vertical shaft, toestep and top bearings, driving wheel and pinion is £60.

Approximate weight, 2 tons.

GOWANS' ARRASTRA.—Fig. 6011 shows a simple and efficient means of grinding concentrates. The pan is provided with granite bottom against which granite mullers are caused to rotate by means of the bevil gear above the pan; this is driven by belt and pulley as shown; the wrought iron frame is made in halves for ease of transport, and each machine will deal with about the same quantity of material as the Berdan pan last referred to.

The price of Gowans' Arrastra complete, as illustrated, is £58.

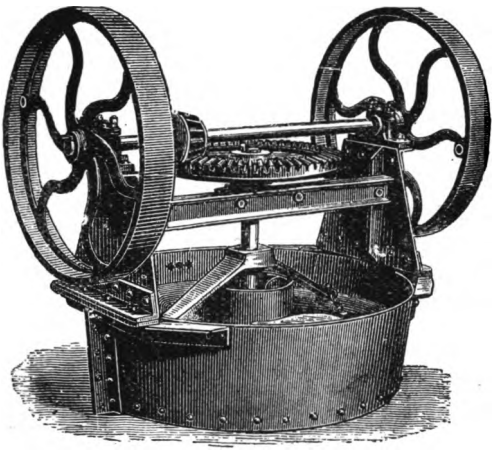


Fig 6011.

GOWANS' GOLD SAVER, (not illustrated).—The object of this invention is to force the particles of gold into the mercury. No doubt most of the bullion will be amalgamated by being pressed by the muller on to the face of the mercury, but the extremely fine particles and those which rest on a grain of sand may escape if they are not forced into the mercury, as provided for in this machine.

The gold saver can be used with any existing mill, either as a "save all" in conjunction with any form of concentrator, or in substitution for them.

The results obtained with this machine indicate that it saves more than its first cost in a very short space of time.

PRICES OF GOWANS' GOLD SAVER.

Average duty per day .. .. tons	10	15
Price of gold saver with driving gear	£65	£75
Approximate weight .. .. tons	1½	1½

CLEANING UP PANS, or amalgamating barrels are most useful adjuncts to a gold milling plant: the barrel is made of cast iron, about 4 ft. long, and 2 ft. internal diameter, supported on short shafts which are carried in bearings on an iron frame; one of these shafts is fitted with fast and loose pulleys, by means of which the barrel is caused to revolve. Water tight doors, usually about 10 by 6 in. are provided at one or both ends for rapidly emptying the barrel and a smaller one for washing out.

The materials with the mercury and amalgam obtained in the clean up of the mill, together with a number of heavy cast iron balls, are placed in the barrel which is then nearly filled with water: to this is added a quantity of mercury in proportion with the quantity of gold which the charge is expected to contain and, after the doors have been closed, the barrel is slowly rotated until a complete amalgamation has been obtained; this usually requires 3 to 6 hours and when finished a handhole is opened and that portion of the contents of the barrel which is worthless is washed out into the sluice box, the bulk of the mercury being allowed to remain in the barrel until it has become sufficiently charged with gold, when it is treated in the usual way.

The price of the amalgamating barrel as above described is £35 and the power required to drive it is 2½ I.H.P.

CONCENTRATING MACHINERY.—In cases where the ore is not free milling, some system of concentrating the tailings has to be employed, and the nature of the ore is the only guide as to whether coarse or fine concentration should be adopted. For coarse concentration some form of fine jig buddle or shaking table, is used, and in such cases the ore is pulverized accordingly; but for fine concentration the ore must be crushed to a fine sand and similar, but more perfect means of concentration including vanners, have to be employed.

THE BUDDLE is perhaps the oldest method of concentrating and is still largely used for certain classes of ore.

But the construction of these machines is so well known, that a detailed description is not necessary here and the conditions under which they are used vary so widely, that reliable estimates for the Buddle complete with wrought iron pan, or for the head driving gear, &c. only, cannot be made without information in regard to what is in each case required.

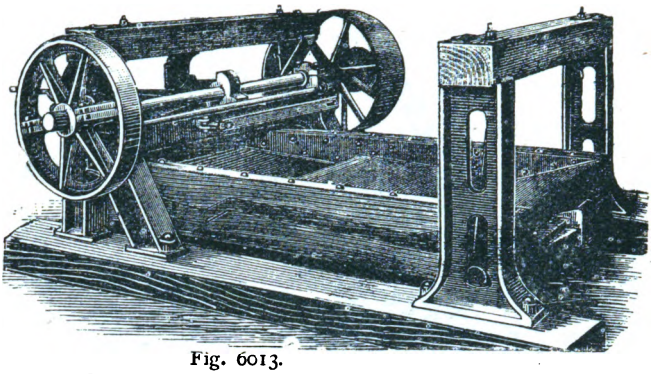


Fig. 6013.

SHAKING OR PERCUSSION TABLES.—Fig. 6013 illustrates a type of machine largely used in Australia and, with certain improvements—suggested during practical work—these machines are very effective.

The table which receives the tailings, is about 8 ft. long and 4 ft. wide, and is suspended by rods from the cross beam, as shown; the rods are screwed at their upper ends and provided with nuts for adjusting the angle at which it is desired to work. The percussive action is obtained by the rotation of a cam, a spring at the other end driving the table back and bringing it in contact with a buffer block. This causes the metallic or heavier particles to be deposited on the table, the slimes being carried away, by the flow of water, to the flume.

One machine is required for each 5 head of stamps and they are arranged to work in pairs.

The price of the machine with timber frame is £75.

Ditto ditto iron frame £85.

The usual speed of the driving pulleys is 60 revolutions per minute and the weight is about 1½ tons. The cost of packing for shipment and delivery f.o b. is 5 per cent.

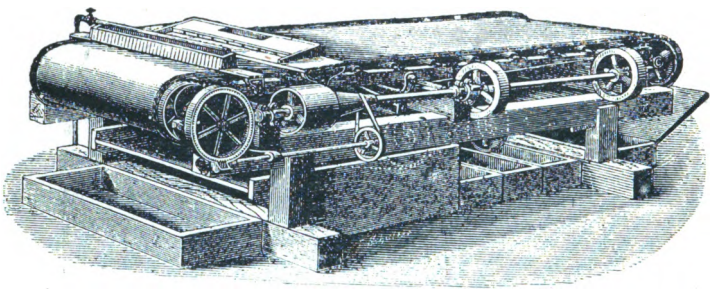


Fig. 6014.

THE VANNER, Fig. 6014, is specially adapted for fine concentration and consists of a strong frame which carries the table, driving gear and all appliances for working the machine.

The table is formed of an endless India rubber band, revolving over end rollers; it is supported by intermediate rollers, and has a surface of 12 ft. long by 6 ft. wide. The angle of the table is adjustable to suit the ore to be treated, and the band is driven by suitable gear attached to the frame.

The pulverized ore is delivered over the whole width of the belt, so as to distribute it quite evenly over the travelling band.

The process of separation is greatly accelerated by hydraulic jets in front of the table, which give the necessary supply of water on the travelling band, and drive back the lighter portions of the ore, leaving the heavier particles on the belt which conveys them to a receiver below the table, whence they are removed from time to time.

Two of these machines are required to deal satisfactorily with the output from each 5 head of stamps.

The price of the vanner with timber frame and as above described is £110.

Do. do. iron frame do. do. £125.

One horse-power will drive two machines and the approximate weight is 18 tons.

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

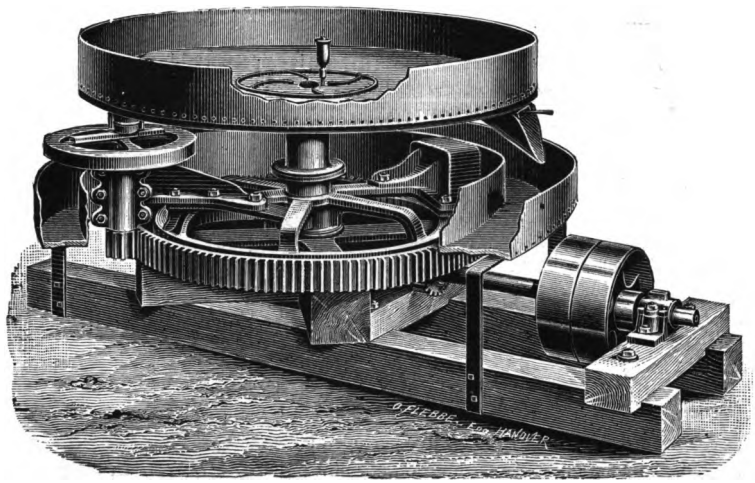


Fig. 6015.

CENTRIFUGAL CONCENTRATOR, Fig. 6015.—This machine differs from those last described inasmuch as the concentration is obtained by centrifugal instead of by a "jigging" motion. The pan is driven by gearing underneath as shown in the engraving, and the motion imparted to the machine produces a result similar to that obtained from a prospecting pan or vanning shovel as used by the experienced miner. The delivery is continuous and automatic, and the machines can be adapted within a very few minutes to suit varied grades of ores. Each machine deals with about the same quantity of tailings as the shaking tables previously described, two being required for each 10 head of stamps, but they are generally arranged in sets of three, the tailings from the first two being led into the third one for final concentration, in precisely the same manner as with other concentrators.

The sulphurates and other heavy particles naturally flow towards the outer circle of the pan, and settle to the bottom, whilst the lighter und valueless particles escape through the central discharge. A transverse movement obtained by an eccentric below the pan greatly assists the separation of the heavy from the light particles.

The price of the centrifugal ore concentrators as above described is £80; and a set of three with countershaft, pullies, and belt costs £276.

The cost of packing for shipment and delivery f.o.b. is from 5 to 8 per cent.

BATEAS.—This appliance, not illustrated, consists of an oval or round shallow pan of cast iron about 4 ft. diameter and 4 in. deep with a rounded bottom and a plug in the centre. The pan is supported on a roller at one end and suspended at the other by a couple of rods; motion is imparted to the pan by a vertical pin, driven by bevel gear beneath the pan and the pan being rapidly revolved, a gyratory motion is set up similar to that used in panning up amalgam in the hand prospecting pans.

The price of the Batea as above described is £30 and the power required to drive it is 1 I.H.P.

DRY SEPARATION AND CONCENTRATION.—Gold extraction by the dry process is necessary where water is not available, and sometimes for prospecting purposes it is an immense advantage to be able to dispense with the use of water; the machines now described are the invention of Mr. C. Wetzlar and are recommended in cases where water is scarce and the ore is sufficiently dry to be treated by this process. In Western Australia especially, where these conditions occur, this process has been used with the most satisfactory results.

The principle of the machine is simple; the dry pulverized ore is fed through a hopper and is thrown by a strong current of air, impelled by a fan or blower, against a perforated jigging screen; the upper surface of this screen is well covered with shot and the gangue is carried over it passing away as tailings; the heavier particles fall by gravity among the shot and sink through the screen into a collecting trough as concentrates.

The current of air is adjustable and the concentrates can be produced either free or with any desired percentage of "gangue" for chlorination, roasting, smelting or other further treatment.

The machine requires little power to drive it and is very portable. It can be worked by unskilled labour and acts automatically when once adjusted; an additional advantage is that the concentrates are collected in a closed box, which can be locked and kept under the direct supervision of the mill manager.

The price of this separator capable of treating 10 to 15 tons per diem is £200: the weight is 6½ cwt, and about one h.p. is required to drive it.

In addition to the above mentioned machine, there is a machine for the working of free milling ores, and the extraction of gold therefrom as well as for treating alluvial, gravels and placer earths; the price of this machine, capable of treating 100 tons per diem is £150: the weight is 5 cwt. and about ¼ h.p. is required to drive it.

A hand power prospecting machine is made on the same principles as that above referred to and, owing to its extreme portability, is invaluable to prospectors who have to penetrate difficult country—especially so where the use of water and mercury is almost impossible.

The machine weighs only 6 lbs. when fully equipped with all tools, &c., for prospecting, and it makes a perfect separation of the valuable metals from the "gangue" in a very short time.

The price of a small machine as above described is £12 fully equipped with prospecting tools, &c.

A larger size, to treat from 15 to 25 lbs. per operation is £25.

A separate machine for dry concentration, also invented by Mr. Wetzlar, deserves mention here, all classes of ore and especially those in which "flake" gold is met with having been treated most successfully by it. The arrangement of the machine is similar to that described above, an exhaust of air being used however, in place of the blast.

The price of this concentrator capable of treating 30 to 40 tons per diem is £250, and about 2 h.p. is required to drive it.

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

SIZING AND CLASSIFICATION.—It is now generally recognised that the process of concentrating minerals of all kinds, is materially assisted by classifying or—as completely as possible—separating particles of equal volume from those of different volume, before they are concentrated.

This volumetric classification prepares the ore for concentration which (whatever system may be adopted), is based on the natural law that, if particles of equal dimensions, but of different specific gravity, are simultaneously dropped in water from a given height, the heavier particles will be the first to reach the bottom. But the appliances used for this purpose are so numerous and varied that it is hopeless, in the space now available, to do more than refer briefly to those in common use.

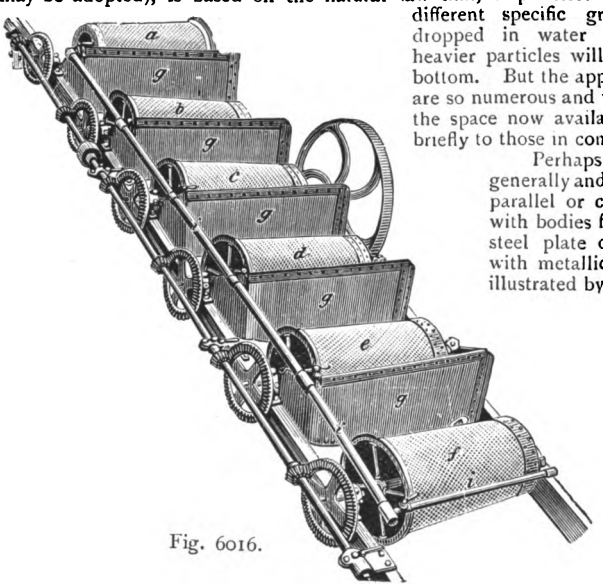


Fig. 6016.

Perhaps no system of separation is so generally and successfully employed as the parallel or conical revolving trommels, with bodies formed of perforated iron or steel plate or—for fine concentration—with metallic gauze, types of which are illustrated by Figs. 6016 to 6018.

Fig. 6016 represents a compact and (if the ore is suitable) effective arrangement for making six separations. The finest is delivered from the uppermost (*a*), of the series, the coarse particles being passed from the hopper (*g*) to the next trommel; this delivers the next finest separation and so on to the bottom screen (*f*) which is the coarsest.

As will be seen from the engraving, power is transmitted, by belt, from the main pulley, that for driving each trommel being obtained from the longitudinal shaft and gear, as shown.

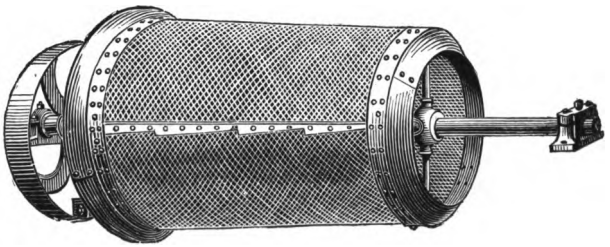


Fig. 6017.

Fig. 6017 is a conical revolving screen with central shaft and driving pulley, the gradation of perforation being made to suit the ore to be treated.

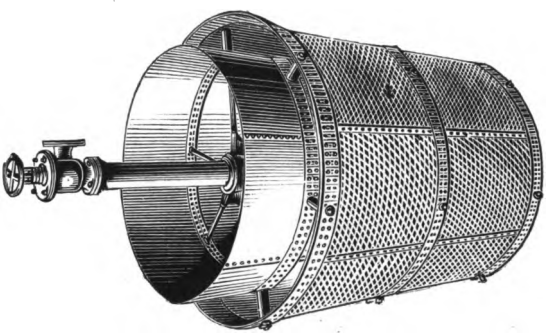


Fig. 6018.

Fig. 6018 is a compound trommel with internal and external screens and with or without a hollow shaft and fittings for water supply.

All these trommels are made of the dimensions and with the sizes of perforations required.

Other types of classifiers, largely used, consist of a series of flat screens fixed at the requisite angle and provided with apparatus to give a vertical, transverse or longitudinal jigging action, or a combination of these, but, for the reasons already given, details relating to these and many other useful appliances, must remain subjects for special consideration and negotiation.

THE CYANIDE PROCESS, for extracting gold from tailings is based on the fact that gold is soluble in a solution of cyanide of potassium when in contact with air; its use on a commercial scale is of comparatively recent growth, but it is now in profitable operation on most gold fields and is an established success. In South Africa especially it is largely used with the most satisfactory results, and the fact that more than 25 per cent. of the total output of gold which, at this date, is more than 182,000 ounces per month from the Witwatersrand gold fields is extracted by this process, is sufficient evidence of its value, and, as the cost of treatment by the usual process rarely exceeds four shillings per ton, it is profitably employed even on very low grade tailings; the use of improved appliances invented by Mr. Gowans and referred to later on materially reduces even this low cost.

It scarcely comes within the scope of this work to explain the chemical action involved, but the process may be briefly described as follows: a strong solution of cyanide of potassium is made in a tank and the strength of the solution being determined, it is run off through a fine woven steel wire filter into storage tanks where it is diluted as may be required until its strength is between 0 3 and 0.6 per cent.

This solution is then passed into leaching vats filled to within about six inches from the top with the tailings requiring treatment, and is allowed to percolate through the mass, after which it is drawn off, the vat emptied, and the operation repeated when the vat has been refilled. The time required for this treatment is from six to twelve hours; a weak solution containing 0·2 to 0·4 per cent. of cyanide, generally obtained from a previous precipitation, is then run in and is drawn off after it has acted on the ore for another eight to ten hours. Water is then admitted until the original bulk of fluid is made up and, by percolation through the tailings, carries with it any gold still remaining in the mass under treatment, and so completes the leaching.

The first and second strengths of cyanide in solution, contain probably over 90 per cent. of the gold that was in the tailings, and are run through precipitating tanks or zinc boxes, two sets generally being employed, one for the strong and one for the weak solution; the gold is deposited in these by the action of the zinc shavings, and the solutions are then returned to the dissolving tank for use over again, or allowed to run to waste, the precipitated gold being collected and melted into bullion.

The plant required for this process, as hitherto carried out, is of a simple character, and may be briefly described as follows:—

THE DISSOLVING TANK is a small vat provided with a filter of fine steel wire gauze, through which the solution is led to the storage tanks, but the dissolving tank is sometimes dispensed with and the storage tanks used for both purposes.

THE STORAGE TANKS are generally constructed of timber, with staves 3 to 4 in. thick, thoroughly seasoned, and held in place by strong wrought iron bands the ends of which are secured by bolts; the bottom is made of planks fitted into the staves, and all joints are carefully made with white lead; when fitted with pipes and iron cocks and finished, the insides of the tank should be thickly coated with paraffin paint.

THE LEACHING TANKS are similar to those above described, but are provided with a filter in the bottom, and cocks for drawing off the cyanide solution after it has percolated through the tailings; but if very large quantities of tailings have to be treated, the tanks should be built in cement. The process of charging and discharging the tanks is most economically effected by means of a steam crane working a grab, as illustrated Fig. 2020, Section V.

Timber vats are made in all sizes up to 40 ft. diameter, and the capacities generally used are as follows:—

Diameter of tank	14 ft.	22 ft.	22 ft.	40 ft.
Depth of do.	5 ft.	5 ft.	6 ft.	8 ft.
Capacity, for tailings	50 tons	100 tons	130 tons	360 tons

THE FILTER consists of a frame of stout timber grating, forming a false bottom with about 4 in. space below; upon this is laid cocoa nut matting or other porous substance, and grooves are cut in the bottom of the vat leading to the delivery pipe for carrying off the solution charged with gold. The exhaust tailings are discharged through openings in the sides of the vats, which are closed during the process of leaching, by watertight flaps.

THE PRECIPITATING TANKS, or "zinc boxes," are usually about 20 ft. long, 2 ft. wide, and 2 ft. high, and are divided by transverse partitions into ten compartments. A space is left at the top of the first compartment and a similar space at the bottom of the second compartment, and so on for each of the ten, so that the solution is compelled to travel alternately up and down in its passage through the box; trays of steel wire gauze carrying zinc shavings, which serve as a precipitant, are placed about half way up in the box.

THE PUMPS, COCKS, VALVES, &c., are made of iron, brass, or gun metal being affected by the cyanide solution.

From the foregoing brief description it will readily be understood that an estimate of the first cost of the plant can only be given when the duty required, and the local conditions are clearly defined, but it may be mentioned that a well constructed plant with timber vats, capable of treating 6000 tons of tailings per month costs about £6000, erected at the gold fields ready for work.

PORTABLE CYANIDE PLANT (Gowan's and Appleby's Patent).—The cost of labour in carrying out the cyanide process has hitherto formed a rather important item in working expenses and, in some cases, more or less impervious layers of slimes prevent the solution from percolating freely through the mass of tailings, and so retard the completion of the process.

These unfavourable conditions are provided for by the simple and efficient appliances—based on the principle of subdivision—shown in the accompanying sketch and referred to in the following description; if modification of the subdividing arrangments are required they are easily made to suit circumstances as they arise.

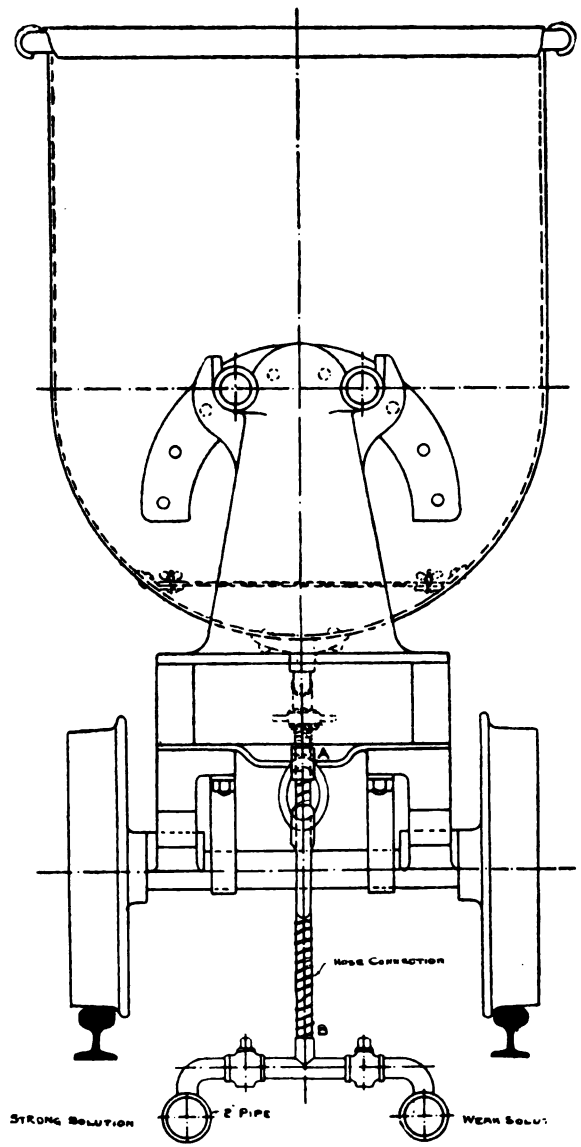


Fig. 6019.

THE TRUCK SYSTEM.—Fig. 6019 indicates a section of the siding where the leaching process is conducted and a filter truck with connection to the two lines of pipes laid at, or near, rail level.

The trucks are made of steel, to tip to either side or to either end, as required, and each truck is provided with a filter arranged to be easily taken out for cleaning or renewal. The short length of flexible pipe with bayonet joint, connects the nozzle from the filter with the solution pipes conveying the leached products to the precipitating tanks, from which the bullion is recovered in the usual manner.

It will be understood that the respective leaching solutions (see the preceding general remarks on the cyanide process) are brought from the storage tanks by overhead pipes or otherwise as may be convenient. But these arrangements are made at the mines and need not now be referred to in detail.

The trucks, as usually made, have a capacity of 26 cubic feet and when they have been loaded with tailings—either automatically by bucket and chain elevator, or by hand—they are run on to the leaching siding and the connection made with the solution pipe.

The solution from the storage tank, of the proper strength and quantity, is then distributed over the surface of the tailings and the cock opened to one or other of the pipes leading to the precipitating tank. So soon as the leaching process has been completed the truck is taken to

the dump and, when emptied, is ready for the next charge.

The quantity of tailings treated in a given time by this system necessarily varies with the character of the tailings, the time occupied in manipulation, &c. but, under ordinary conditions, 20 trucks may be expected to deal with about 60 to 80 tons of tailing per day of 10 to 12 hours.

The price of truck, complete with removable filter and hose pipe connection, including all royalties, is £18, and if a number are ordered, this price will include the cost of delivery f.o.b. in London.

THE CYLINDER SYSTEM (not illustrated) consists of a steel cylinder supported eccentrically, which is provided with a removable filter at one end, and a closely fitting hinged door at the other end.

This cylinder is charged with tailings and the cyanide solution is added in the same manner as in the truck system and the time required for leaching is allowed ; the cylinder is then rotated half a turn and the filter brought to the lowest part, the solution being then drawn off through the filter, and led to the precipitating boxes. Another half turn of the cylinder brings the hinged door to the lowest part and the tailings are discharged through it into trucks or dumped out, the cylinder being then ready for recharging.

The cylinders are constructed of steel plate, with longitudinal joints ; the ends are of steel and the weight of each part is reduced to a minimum ; the heaviest piece weighs only 400 lbs. and even this can be materially reduced if necessary.

The cylinders may be supported upon timber trestles made at the mine, but it is usually found more convenient to obtain the apparatus complete with side frames.

The price of a cylinder complete, to leach 6 tons of tailings at each operation, but without side frames is £90.

The approximate weight is 3 tons.

The price of the apparatus, of the same capacity as above, complete with side frames, or gantry constructed of wrought iron or steel and gear for rotating the cylinder, is £145.

The approximate weight is 4½ tons.

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

THE MERITS OF THESE METHODS OF WORKING ARE BRIEFLY AS FOLLOWS :—

1. Each charge is treated separately and completely without the cost in labour and loss of time hitherto incurred in charging and emptying the large tanks.
2. The tailings are most effectively attacked by the solution, and any layers of slimes which, by the old process, would prevent the free percolation of the solution, are easily and quickly dispersed.
3. The trucks may be discharged when the leaching has been completed and the charge from each cylinder can be emptied into trucks and dumped where convenient, at a distance from the mine without any handling excepting that incidental to haulage.
4. The process of leaching is carried on consecutively, each truck or cylinder being quickly emptied and ready for a fresh charge.
5. The expense of erecting the large tank at the height required for the solution and tailings to be drawn off from beneath is avoided, as well as the risk of leakage, and the contingent loss which is so great in the large vats.
6. Each machine is complete in itself and no skilled labour is necessary for erecting or for working it.
7. Perfect control of the time the solution remains in contact with the tailings.

CHLORINATION.—This process is applied to rich sulphurets, cyanide to poor tailings ; the Californian practise which is perhaps, on the whole, still the best, is as follows : The concentrates are first roasted in a three bedded stationary, or a rotary, or any other form of calcining furnace. The roasted ore is then slightly moistened before it is shovelled into a vat with a double bottom ; the upper or false bottom being perforated and supporting a filter in much the same manner as that described in the foregoing remarks on the cyanide process. Chlorine gas is conducted into the space below the false bottom and gradually rises until it fills the vat. The top is then carefully closed and the whole is left until the action of the gas has been completed and has produced the soluble chloride of gold which is washed out through the filter into other vats, where the gold is precipitated in the usual manner.

Modifications in this process have been the subject of most careful thought on the part of many inventors and patentees, and one process, as developed by Messrs. Newbery and Vautin, is illustrated by Fig. No. 6020. In this arrangement the stationary vats are replaced by two revolving lead lined barrels into which the chlorine is either forced, or within which it is generated by the use of suitable chemicals ; the plant consists of the lead lined chlorinating barrels, already referred to, constructed of wrought iron or mild steel boiler plate ; a lead lined iron leaching vat or filter of improved design ; a leaching pump of special anti-corrosive metal ; an air pressure pump and the necessary lead pipes and driving gear.

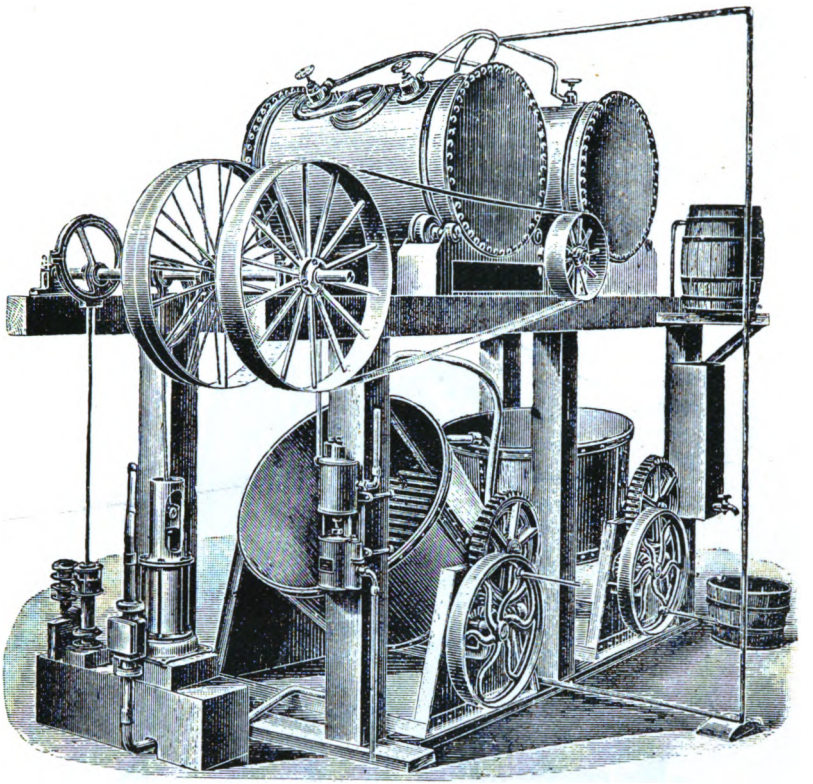


Fig. 6020.

The chlorinating barrel holds about 25 cwt. of crushed ore or concentrates and, under ordinary conditions, about four hours are required for the proper treatment of each charge; the power required for driving the plant is very small, a strong horse gear being sufficient for one or two barrel plants; the cost of treatment varies greatly, but is generally between 15/- and 30/- per ton of ore or concentrates treated.

The special features of this process consist, firstly in the introduction of compressed air into the barrel immediately after it has been charged with the ore and chlorine gas (or the chemicals that produce it); and secondly in the improved method of filtration or leaching.

PRICES OF CHLORINATION PLANT, Fig. 6020.

One barrel plant	£385
Two ditto	£630
Four ditto	£1260

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

From the foregoing the cost of any sized plant may be easily arrived at but as each installation will vary slightly in character according to the nature of the ore, samples of the concentrates or tailings should, if possible, be sent with the order or enquiry; these will be carefully tested free of charge, if the plant be ordered; if the plant is not ordered a charge of £2 will be made for testing concentrates, and for crushing samples of ore the charge is £5. These tests will be most carefully conducted by fully qualified chemists and analysts who will certify the analyses.

THE DIAMOND PROSPECTING MACHINE, Fig. 6021, with which the Writer's name has been identified as patentee, designer and maker, has been largely and successfully used for putting down bore holes, varying greatly in diameter and depth—some exceeding 2000 feet—for ascertaining the depth at which water, metalliferous or other rock is reached, and furnishing tangible specimens of the strata through which the drill has passed.

The machine represented by Fig. 6021 will bore to a depth of about 2000 ft. and consists of a strong tripod frame constructed of steel, mounted on under girders and provided with all appliances required to rotate the drill, to counterweight the rods, and to give a uniform pressure on the cutting head or crown; also to manipulate the boring rods and give the variable supply of water, required for forcing to the surface the small particles of rock resembling sand, which have been cut away by the drill in its downward progress.

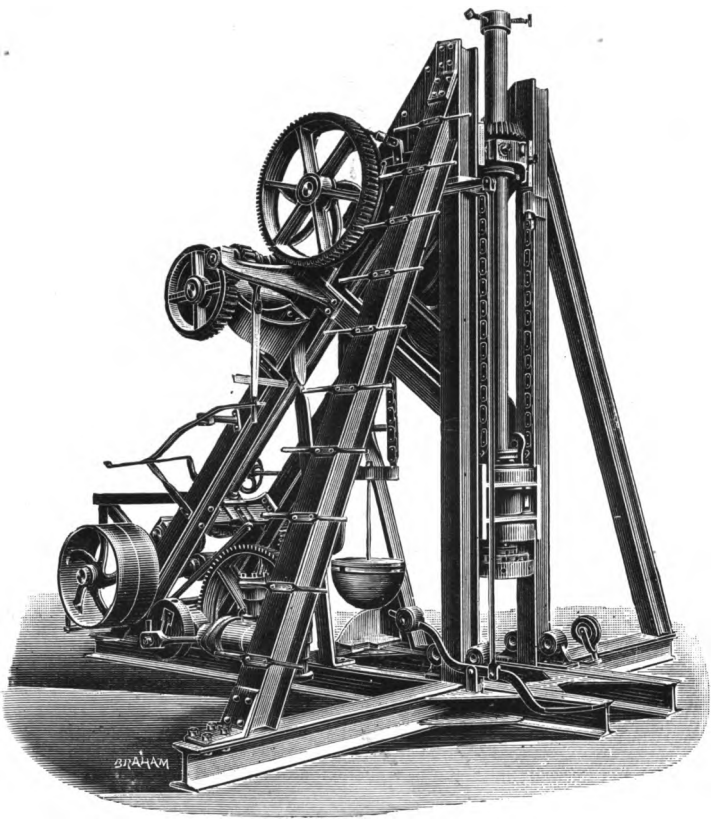


Fig. 6021.

The boring head or "crown" as usually made, is a short length of tube of about the diameter of the hole required, carbonates—known as "black diamonds"—being firmly set in the outer and inner periphery of the face of the tube which is screwed, at the upper end, for attachment to the tubular rods, referred to later on.

This system of boring relies exclusively on the carbonates (the hardest known substance), abraiding and penetrating the hardest rocks; this is achieved by causing the boring head to be rotated under suitable pressure, and an annual groove is thus cut leaving a central core which is removed from time to time and stored in boxes marked, or numbered, to indicate the depth from which the cores have been taken. These are invaluable in estimating the cost of sinking the shaft or of driving an adit to reach the point desired.

The boring rods are made of solid drawn steel tubes with screwed flush joints and are caused to rotate by being clipped in a universal chuck to a revolving quill which has a stroke of 6 ft; shear legs are erected above the machine which support 25 ft. (or more) of boring rods and these are lowered, as required, by the lifting gear on the machine, so that the delay in

boring operations is only that due to the few minutes necessary for lowering the rods and manipulating the universal chuck, the extra length of rod being counterpoised by the addition of weights provided for maintaining an equal pressure on the boring head to which reference has already been made.

When a certain depth has been reached—varying according to the strata—the core clip is used for detaching the solid portion within the annular groove which is slightly less in diameter than the internal diameter of the tubular boring rod. The nature of the strata passed through is being, to some extent, indicated by the debris washed to the surface by the jet of water constantly supplied to the bottom of the bore hole, but the cores should be stored for reference in the manner above described.

In some cases the machine is driven by an engine connected with the end of the first motion shaft, but it is usually more convenient and economical to drive by belt from a portable steam engine, a petroleum engine or other convenient motor.

Borings of large dimensions such, for instance, as 16 in. diameter, producing cores exceeding 3 tons in weight, require a strong timber frame and machinery fulfilling all the conditions referred to in the foregoing description, but differing from it in arrangement. In some cases these machines are mounted on a travelling carriage, with road wheels, shafts, etc., and are complete with engine, boiler, and all accessories

The efficiency of the machine depends to a large extent on driving the rods at the speed and with the pressure which, in each case, will give the best result; these have been ascertained by careful and exhaustive experiments conducted by the Author's firm, the original makers of these ingenious and useful machines.

The price of the machine with single pump, as shown, is about £380.

If with double pumps, the price is £395.

THE ENGINE to drive it should be of about 10 nominal horse power, and the cost of the type most suitable, will be found in the section of this book referring to "Prime Movers," Section I.

ACCESSORIES.—The nature and extent of these is largely influenced by the localities in which the machines will be worked and (to some extent) the probable depth of bore holes to be made. The following articles form a satisfactory outfit for a plant which is intended to work at depths of 1000 to 2000 ft.

Two thousand feet of steel boring rod with screwed joints.
Three unset boring crowns, each 2 and 3 in. diameter.
Two ditto ditto 4, 5, and 6 in. diameter.
Two 15 feet lengths of core tube.
Four core clips.
Two special connections for boring rods and core tubes.
Two ditto rods to 3 in. tubes.
Seven hundred and fifty feet of steel lining tube 3 in. diameter.
Six hundred and fifty ditto 4 ditto.
Three hundred and fifty ditto 5 ditto.
Ditto ditto ditto 6 ditto.
Diminishing connectors, 6 to 5 in., 5 to 4 in., and 4 to 3 in.
Steel driving shoes 3 in. to 6 in. diameter.
Six flexible hose pipes 1¼ in. diameter.
Three pairs of unions and 2 water unions.
One chain sheave with spindle and bearings.
One hundred and fifty feet best tested ¾ in. crane chain.
One set of 3 tons pulley blocks.
Two lifting swivels for rods. One set of eccentric clips.
Two pairs tongs for tubes 3, 4, 5 and 6 in. diameter and 4 rod tongs.
A tool box containing a complete set of tools for setting crowns.
Parallel vice 5 in. Set of spanners. Two shifting wrenches.
One gallon oil can and 2 oil feeders.
Set of spare valves for pumps.
Ditto steel pinions.
Ditto gun metal bearings for main driving shaft.
Ditto driving straps.
Two hydraulic lifting jacks of 6 tons power.

THE APPROXIMATE COST of the entire plant including the prospecting machine, engine and boiler, and the accessories enumerated, is £1400.

CARBONATES.—To this should be added a supply of carbonates for upholding the crowns, but as the prices of carbonates vary considerably from day to day, the cost cannot be accurately estimated beforehand; a very useful supply can however be provided for £200 to £250.

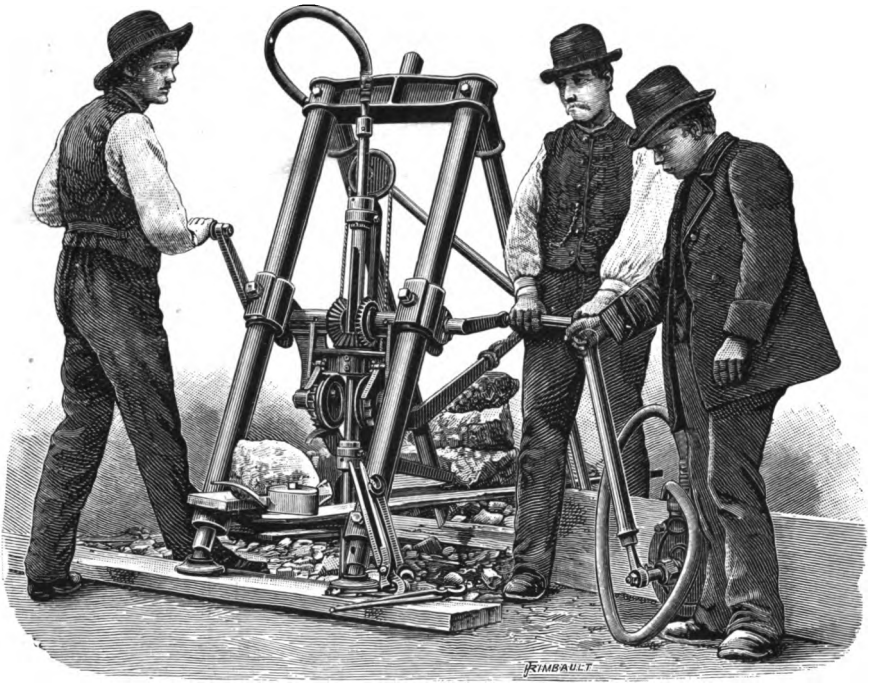


Fig. 6022.

SMALL DIAMOND PROSPECTING MACHINE, Fig. 6022.—The principles of construction are similar to those last described, but this machine is only suitable for testing ground up to a depth of 200 or 250 ft. and is capable of being carried anywhere. The weight of the heaviest piece does not exceed 150 lbs and every facility is afforded for taking down and re-erecting the machine with a minimum of labour and risk of error.

If it is more convenient to drive the machine by steam or animal power than by manual power, a driving pulley is substituted for the handles shown in the engraving.

The diameter of the hole usually bored is 1½ in. and that of the core about ⅞ in. The machine is complete with appliances (not shown in the engraving) for lifting the rods when the core has to be drawn, or if the crown needs attention.

Each machine is sent out with the under named ample equipment of accessories :—

Two hundred feet of steel boring rods with screwed joints.
One crown set with carbonates. Six unset crowns.
Two core tubes. Two core lifters. Two core barrels.
A complete set of spanners.
A parallel vice, drill post and drills.
Cold iron saw frame and saws.
Drill tube tongs. Crown chuck.
Hand pumps, flexible suction and delivery hose, unions, &c.
A tool box containing a complete set of tools for setting crowns.
The price of the machine complete with accessories as specified is £180.
Extra crown complete with carbonates £24.
Do. steel boring rods with screwed ends 2/6 per ft.

The measurement as shipped is about 40 cubic feet and the cost of packing for shipment and delivery f.o.b. is 5 per cent.

DIAMOND PROSPECTING MACHINES of the type illustrated by Fig. 6023, are similar in principle to those previously described, and combine all the improvements introduced in the most recent American practice. They are arranged to be adjusted and fixed at any angle and are capable of boring horizontally, at an angle, or vertically to any depth up to 1000 ft. and of bringing up solid cores showing the exact character of the ground passed through for the entire distance.

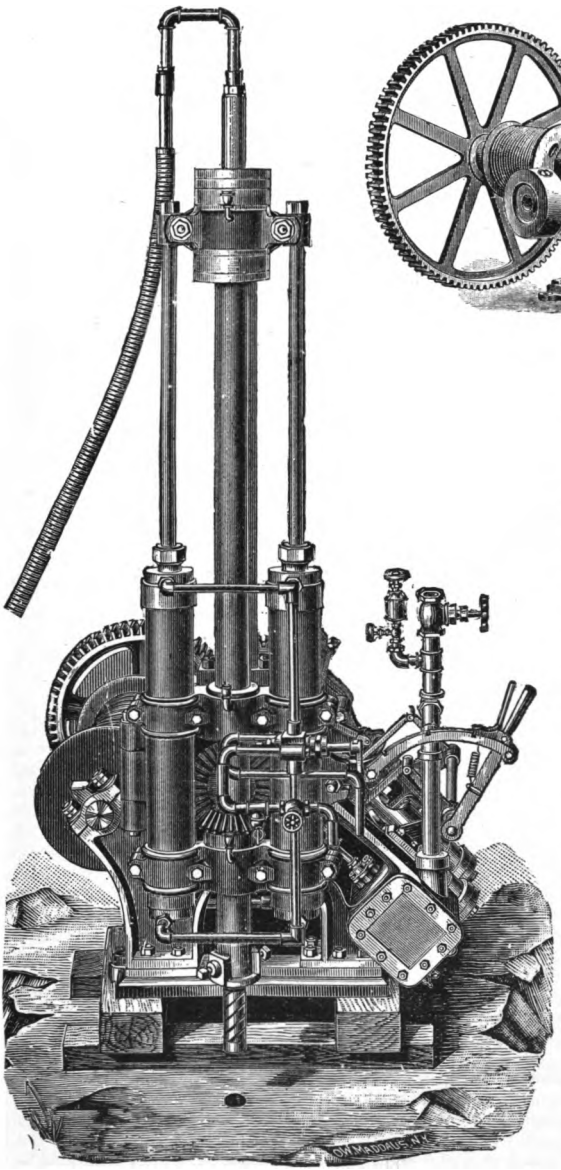


Fig. 6023.

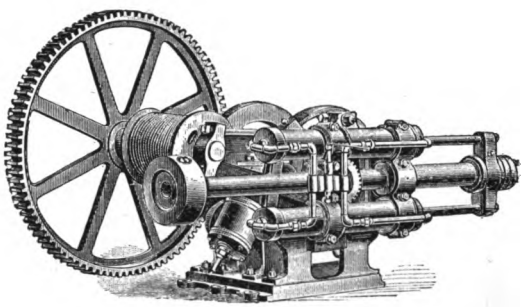


Fig. 6024.

The machine is complete with its own engines for driving the drill and has a winding gear also driven by the engines for lifting the rods to extract the cores, to put in additional lengths, &c., and is complete with all appliances for feeding the drill forward, and for providing the supply of water required to clear the bore hole of debris.

The accessories required for proper and efficient working, (other than the tools mentioned later on), necessarily vary according to circumstances, but for putting down a bore hole, which will not occupy much time, a tripod over the drill, constructed of timber and arranged to carry a lifting block at the top, usually answers every purpose. If however the drill is to remain for a considerable time, (as sometimes is necessary) as for instance, when putting down a deep bore under circumstances which do not admit of the work being carried on without intermission, it may be desirable to erect a more permanent structure.

The machine is strongly and simply constructed, and is easily handled by an intelligent mechanic. The diamonds (carbonates), forming the cutting surface, are so immeasurably harder than any rock they have to perforate, that the repairs are very small and, with ordinary care, the carbons will not be lost or injured.

The undernamed form the usual equipment sent with each machine: 200 ft. of boring bars, one diamond crown, two blank crowns and a set of diamond setting tools with instructions for using them, a core lifter, a core barrel, safety clamp, hoisting swivel, independent steam pump, hose pipe and coupling, and the tools required for working and maintenance.

The price of the machine complete as described is £795.

If with multitubular boiler and feed pump mounted on a wrought iron carriage with road wheels, shafts &c., the price is £865.

THE HORIZONTAL DIAMOND DRILLING MACHINE, Fig. 6024, can be swivelled and fixed to work at any angle, is capable of putting down a hole about 800 ft. deep, and is much used for open quarrying, heading driving, shaft sinking, or other purposes.

The price of the drill complete with outfit as last specified is £610.

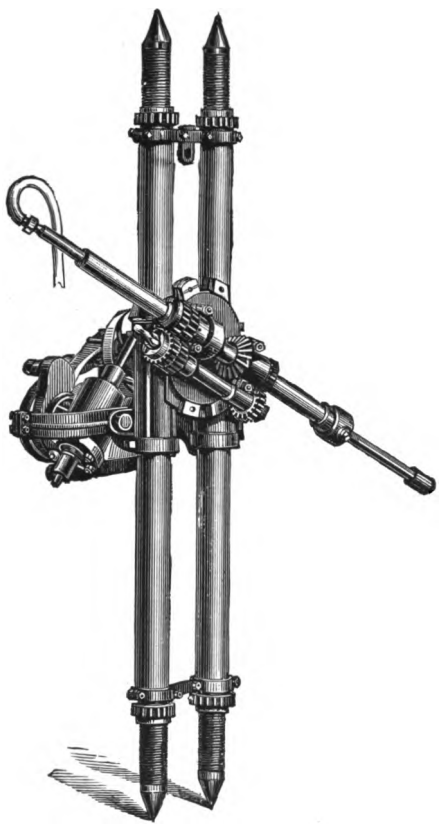


Fig. 6025.

THE PORTABLE STANDARD DIAMOND DRILL, Fig. 6025, is complete with engines and arrangements for swivelling and fixing the boring bars at any angle. It will be seen that the standards are quite easily fixed vertically or horizontally or in other positions desired for sinking shafts or driving headings.

The machine is complete with engines to be worked by steam or by compressed air and the equipment, as follows: 20 ft. of boring rods, one crown set with diamonds, two blank crowns ready for setting, one core barrel, core lifter, combination vice, breast drill, a set of twist drills $\frac{1}{16}$ to $\frac{1}{4}$ in., three mechanics' hammers, two oilers, set of steel wrenches, a set of diamond setting tools, bit holder and gauge, six files and 1 lb. of copper wire.

The price of the drill, with outfit specified, is £325.

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

PERCUSSION DRILLS FOR DEEP BORING.—Until the diamond drill was invented and perfected, deep bore holes were almost always put down by percussion drills, differing in details of construction, but all relying on the principle of disintegrating the rock by a constant repetition of blows caused by the falling weight of steel tools of various sections and dimensions.

The progress was slow and the formations passed through could only be approximately ascertained. The diamond drill performs the work in about one-tenth of the time, and leaves cores, which show precisely the thickness, dip, &c., of the formation and depth from which they are taken.

The appliances used for this system of drilling comprise a strong and rather costly timber headstock or "Derrick," as it is named in the United States of America and in Canada. The height of the headstock is usually from 40 to 50 ft., with a V grooved pulley at the top to carry the rope or chain to which the jumper rods and drill are attached; the other end coils on a drum which is rotated by steam, animal or manual power. The action, therefore, is similar to that of a pile driver, the weight and shape of the tool, and the height and frequency of the drops being regulated by the foreman in charge.

This mode of drilling and the approximate cost of the machinery, are mentioned because cases may arise where the system may be conveniently adopted. As already indicated the "Derrick" is built at the proposed boring. The quantity of timber required for its construction will probably be 8,000 to 10,000 cubic feet and the value of nails, bolts, &c., will be about £25.

Work of this kind is usually done by a contractor who provides his own drilling tackle which costs about £350.

The cost of the engine, boiler, lifting gear, rope or chain, headstock pulley, &c., rarely exceeds £225.

Fig. 6026.

THE MARSTON ROCK DRILL, Fig. 6026, is adapted to work by steam or compressed air and has gained a good reputation in drilling very refractory rock, and for low cost of maintenance. The drill is attached by a universal clamp to a tripod, as shown, to a stretcher bar, or to a multiple drill carriage as may be required and is available for every kind of work, such as putting down holes in any position, in quarrying, driving headings, shaft sinking, &c.

The two larger sizes are found to give the best results in heading or tunnel driving because, as is well known by experts—time of working and charges of explosives being equal—a relatively larger quantity of rock is brought down when the holes are large, than when they are small.

A certain length of flexible hose is required for each drill to give sufficient range of work without removing or laying fresh mains during working hours, but wrought iron pipes cost less and are far more durable for that purpose than the best flexible hose, so that the length of the latter,, for each drill, rarely exceeds about 50 ft.

PRICES OF ROCK DRILLS, FIG. 6026.

Diameter of cylinder .. .. inches	2½	3	3¼	4
Price of drill	£40	£47	£53	£60
Ditto tripod with weights	£6	£6	£7	£8
Ditto stretcher bar and clamp	£9	£9	£10	£10
Ditto set of 20 steel drills	£7	£8	£9	£10
Ditto flexible hose per foot	3/-	3/-	3/-	4/-
Ditto set of gun metal unions	14/-	15/-	16/-	20/-

The cost of packing for shipment and delivery f.o.b. is 6 per cent.

COMPOUND ROCK DRILLS are similar in appearance to those illustrated by Fig. 6026, but a great saving in the consumption of compressed air or steam is obtained by the use of high and low pressure cylinders, as in a compound steam engine. The pressure admitted to the small cylinder, passes to the larger cylinder, and thence to exhaust in the usual manner.

The economy attained by the use of the compound drill has been variously estimated at, from 25 to 40 per cent. and, where several drills are at work this represents an important saving in the consumption of fuel which, in conjunction with the saving in the initial cost of the smaller compressing plant, pressure mains, hose, &c., required for this system is well worth serious consideration. This ingeniously simple arrangement involves no complication of parts and the cost of maintenance is practically the same as for the high pressure drills.

The dimensions of cylinders given in accompanying list are those of the high pressure cylinders.

PRICES OF COMPOUND ROCK DRILLS.

Diameter of horse power cylinder .. .. inches	3	3½	3½
Price of drill	£52	£55	£60
Ditto tripod weights, and clamps	£16	£17	£18
Ditto stretcher bar	£4 10 0	£5	£5 10 0
Ditto universal clamps	£4 16 0	£5	£5 10 0

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

AIR COMPRESSORS, RECEIVERS, &c., vary so much in dimensions and design that reference can only be made to those which are in general use in connection with rock drilling plant of moderate proportions, such as those specified later on. Estimates will however be given for compressing plant of larger dimensions for drilling, tunnelling by the shield system, sinking caissons, or any other purpose, on receipt of details of the conditions to be fulfilled.

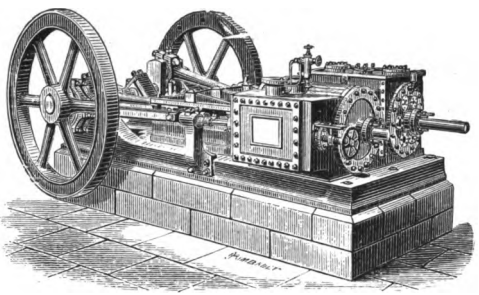


Fig. 6027.

FIXED COMPRESSOR AND ENGINE, Fig. 6027.—The steam and air cylinders are fixed side by side at one end of a massive bed plate, the valve chests for both steam cylinder and air compressor being perfectly accessible for examination, without interference with the rest of the engine. The crank shaft is provided with two fly wheels, as shown ; the cranks are set to give the highest useful effect and in design and construction this object has been kept steadily in view.

The list gives the sizes in general use, but several other dimensions are made and prices for them will be given on application.

The boilers are of the locomotive type and are complete with chimney and all fittings, including steam and exhaust connections for a moderate distance—say about 20 ft.—between engine and boiler.

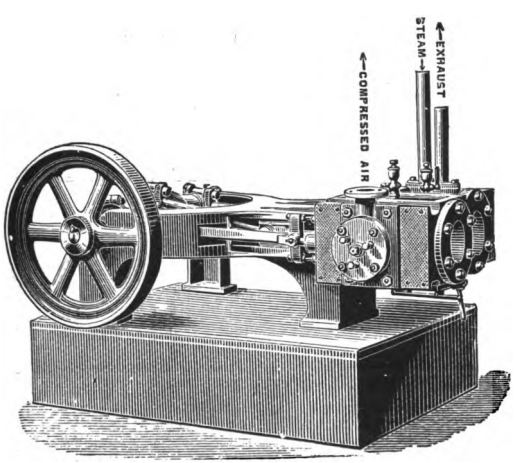


Fig. 6028.

THE COMPRESSOR AND ENGINE, Fig. 6028, is intended to supply compressed air for a small number of drills. The smallest size drives one drill, the second, two small drills and the largest size two 4 in. drills.

It is almost invariably desirable to have a boiler for the special service of the drills and, for a plant such as last referred to, one of the vertical type, Fig. 1049, Section I., with crosstubes, chimney and all fittings, is commonly used for quarry work, open cutting, &c.

PRICES OF AIR COMPRESSORS, &c., Fig. 6027.

Diameter of air cylinder inches	10	12	14	16	18	20
Do. steam do. ,,	10	12	14	16	18	20
Length of stroke.. .. ,,	16	16	24	24	30	30
Price of compressor	£230	£280	£355	£415	£560	£615
Patent expansion valve, extra ..	£20	£22	£25	£30	£35	£37
Loco. boiler and connections ..	£125	£145	£198	£236	£297	£317
Wheels, fore, carriage, &c , extra	£17	£22	£25	£30	£35	£35

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

PRICES OF AIR COMPRESSORS, Fig. 6028.

Diameter of air cylinder .. .. .. inches	6¼	8½	10
Do. steam do. .. .. .. ,,	7½	10	12
Price of compressor	£70	£90	£115
Do. vertical boiler, type Fig. 1049 Section I.	£50	£60	£74

ROCK DRILLING PLANT, ESTIMATE A—The machinery comprises a compound, or high pressure direct acting engine of 30 nominal horse power with variable expansion valves to steam cylinders and patent inlet and outlet valves to the air compressing cylinder. The boiler is of the locomotive type and is complete with all fittings and connections, including donkey steam feed pump The air receiver is of steel, and is provided with a pressure gauge and all mountings and connections.

The equipment of drills consists of six drills with 3½ in. cylinders, five stretcher bars and universal clamps, 250 ft. of special rubber hose, in five lengths, with hose couplings and gun metal main cock to each length. Also 100 steel drills of lengths up to 5 ft., a set of drill sharpening tools and an ample supply of spare parts for the engines, compressor and the drilling machines.

ROCK DRILLING PLANT ESTIMATE B.—The equipment is precisely as specified in estimate A excepting that the engines and boiler are of 20 nominal horse power and the drills have cylinders 3 in. diameter.

Under some conditions, this plant give results quite as satisfactory as that described in estimate A but if the strata is hard, or the maximum quantity of work is required in a given time, it will be desirable to put down the more powerful plant.

APPROXIMATE PRICES OF ROCK DRILLING PLANT.

	A	B
Complete to specification..	£1485	£1085
Price with compound engine	£1340	£1027
,, high pressure engine		

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.
If exceptionally small packages are required, this cost is somewhat increased.

CYLINDRICAL AIR RECEIVERS.—To insure a steady supply of compressed air to the drills, a receiver of ample capacity is fixed in any convenient position relatively with the drills, by preference, near to the compressor.

The shell of the receiver is made of mild steel plates rivetted by hydraulic machines and tested to a pressure of 150 lbs. per square inch. The fittings consist of flanged connections for inlet and air supply pipes, blow off cock, safety valve and dial pressure guage.

The under named are useful sizes but receivers of any other dimensions or construction are made, as may be required.

PRICES OF CYLINDRICAL AIR RECEIVERS.

Length of receiver .. ft.	8	10	12	15	20	20
Diameter ,, .. ft.	3	3½	4	5	5	5½
Price ,, ...	£33	£42	£55	£70	£98	£118
Contents .. .. cub. ft.	56	95	144	285	392	460
Approximate measurement ,,	80	115	180	332	445	525

The cost of packing for shipment and delivery f o.b. is 5 per cent.

PORTABLE DIRECT ACTING COMPRESSORS.—The steam cylinder and the air compressing cylinder are fixed on a cylindrical air receiver; the compressor piston is worked by a rod connected with the steam piston, and the crank shaft carries two fly wheels to insure steady running.

The receiver is constructed of mild steel plates and is tested by hydraulic pressure to 150 lbs. per square inch. The fittings consist of inlet and outlet valve, blow off cock fixed at the lowest part of the receiver, pressure gauge and safety valve.

If mounted on travelling wheels and provided with shafts, the cost of which is given in the list of usual sizes and prices, the compressor is easily transported to any place where its services are required.

PRICES OF PORTABLE AIR COMPRESSORS.

Diameter of air cylinder .. .. in.	8	10	12
,, ,, steam cylinder .. .. in.	8	10	12
Length of stroke .. .. in.	12	14	14
Price of compressor and receiver	£130	£170	£200
Approximate measurement .. .. .. cub. ft.	150	220	270
Extra for road wheels and shafts	£30	£30	£33
Locomotive boiler, fittings and connections	£95	£125	£147

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

BORING TOOLS for testing ground for minerals, foundations, water, &c., have been designed to suit the varied conditions under which they have to work; those in general use are illustrated on the annexed page, Fig. 6029, and consist of:—

1.—Well rod, usual length 10 ft.
2.—Worm auger.
3.—Open auger, for clay.
4.—Flat chisel, for stone or flint.
5.—Spring dart, to draw faulty pipes from the bore hole.
6.— Ditto ditto, for smaller pipes.
7.—Bell screw, for withdrawing broken rods.
8.—Bell box, for ditto
9.—Auger nose shell, with valve for loose soil or sand.
10.—Flat nose shell, for similar purposes.
11.—Shoe nose shell, for harder ground.
12.—Hand dog, for screwing and unscrewing the rods.
13.—Pipe clams, or rests.
14.—T-Chisel, for flint or stone.
15.—Wad hook, for withdrawing stones, &c., which may fall into the bore hole.
16.—Spiral augular worm for withdrawing broken rods.
17.—Diamond or drill-pointed chisel, for hard ground.
18.—Lifting dog, for raising and lowering the rods.
19.—Long pipe clams or rests.
20.—Tillers or levers for turning the rods.
21.—Wrought iron screwed well bore pipe.
22.—Short rod, with swivel head.
23.—Crow's foot for extracting the broken rods from bore hole.
24.—Pair of well rod joints ready to shut up for greater lengths.
25.—Pipe tongs or heaters for making joints in pipes.
26.—T-piece or pipe dog for lowering the pipes.
27.—Brazed and collared pipe, with water-tight soldered joints.
28.—Common rivetted pipe, strong make.
29.—Spring hook to be attached to well rope for raising tools, &c.
30.—Windlass complete, for boring or sinking.
31.—Strong well sinking bucket.

The following estimates will suffice to establish the cost, with sufficient accuracy, for an equipment of tools for almost any depth or formation.

BORING PLANT FOR THIRTY FEET DEPTH consists of five 5 ft. lengths of boring rods and one swivel rod, one 2 in. clay auger, one 2 in. shell nose auger with valve, one 2 in. flat chisel, one 2 in. worm auger, one spring hook, one pair of tillers, one lifting dog and two hand dogs or wrenches.

The price of this set of tools is £12 10 0.

BORING PLANT FOR FIFTY FEET DEPTH consists of ten 5 ft. lengths of boring rod and one swivel rod, one clay auger each 3½ and 2½ in., one shoe nose shell with valve each 3 and 2 in, one flat chisel each 3½ and 2½ in., one T chisel each 3½ and 2½ in., one worm auger, one spring hook and 30 ft. of rope, one pair of tillers, two lifting dogs, two hand dogs, one rigger and carriage.

The price of this set of tools is £28.

Extra length of boring rod, per 5 ft. length is 18/6.

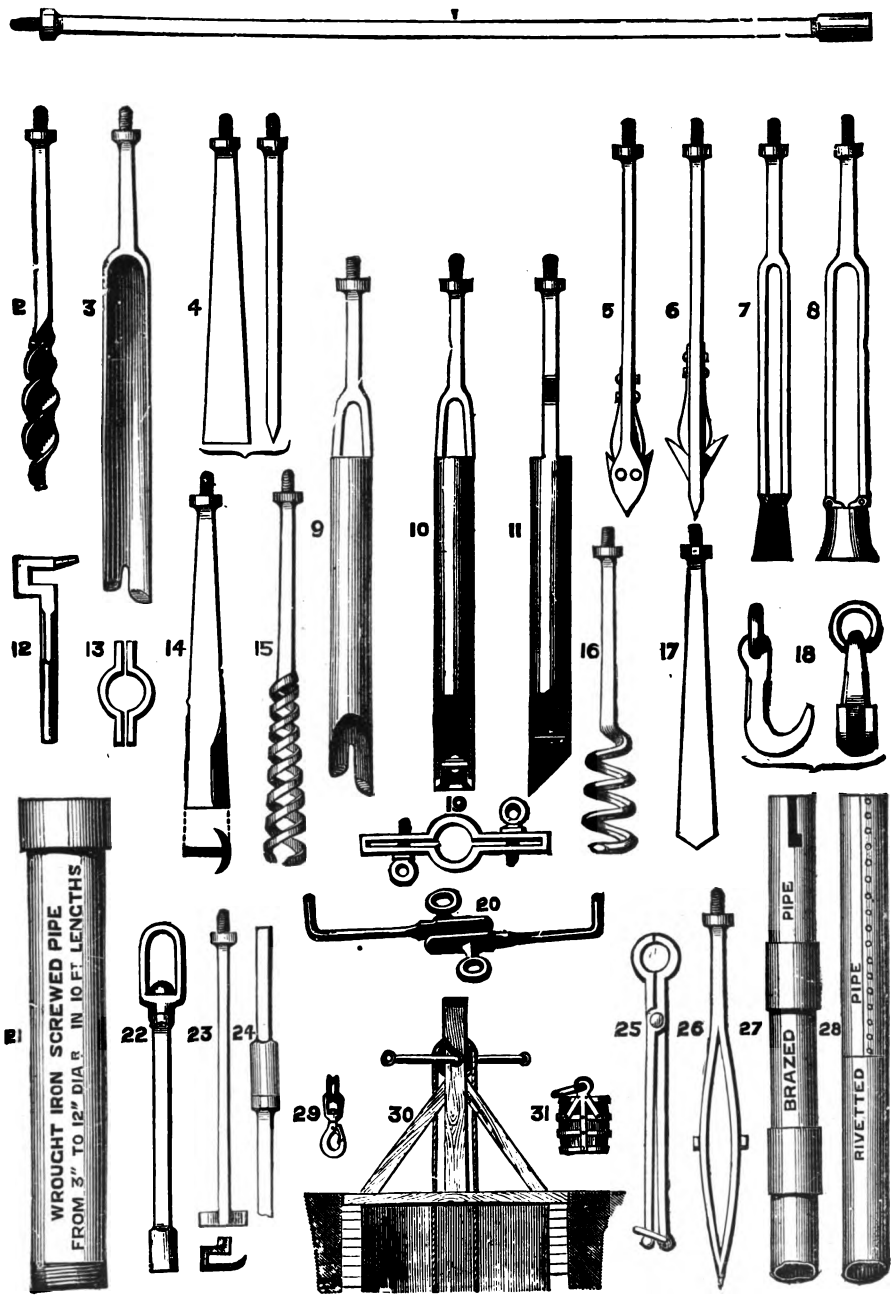


Fig. 6029.

BORING PLANT FOR ONE HUNDRED FEET DEPTH consists of ten 10ft. lengths of boring rod and one swivel rod, one clay auger each 4¼ and 3¼ in., one shoe nose shell with valve each 4 and 3 in., one auger nose shell each 4 and 3 in., one flat chisel each 4¼ and 3¼ in., one T chisel each 4¼ and 3¼ in., one worm auger, one spring hook and 30 ft. of rope, one pair of tillers, two lifting dogs, two hand dogs, one bell box, one rigger and carriage, one auger board and one auger clearer.

The price of this set of tools is £40.

Extra length of boring rods, per 10 ft. length, £1 1 0.

BORING PLANT FOR TWO HUNDRED FEET DEPTH consists of twenty 10 ft. lengths of boring rod and one swivel rod, one clay auger each 5¼, 4¼ and 3¼ in., one shoe nose shell with valve each 5, 4 and 3 in., one auger nose shell each 5, 4 and 3 in., one flat chisel each 5¼, 4¼ and 3¼ in., one T chisel each 5¼, 4¼ and 3¼ in., one worm auger, one spring hook with 30 ft. of rope, one pair of tillers, two lifting dogs, two hand dogs, one bell box, one rigger and carriage, one auger board, and one auger cleaner.

The price of these tools is £64.

Extra length of boring rods, per 10 ft. length, £1 4 0.

BORING PLANT FOR THREE HUNDRED FEET DEPTH consists of thirty 10 ft. lengths of boring rod and one swivel rod, one clay auger each 6¼, 5¼ and 4¼ in., one shoe nose shell with valve each 6, 5 and 4 in., one auger nose shell each 6, 5 and 4 in.. one flat chisel each 6¼, 5¼ and 4¼ in., one T chisel each 6¼, 5¼ and 4¼ in., one S chisel each 6¼, 5¼ and 4¼ in., one worm auger, one crows foot, one bell box, one spiral worm, one spring hook with 30 ft. of rope, one snatch block, one pair of tillers, two lifting dogs, two hand dogs, one bell box, two rod rests, one rigger and carriage, one auger board and one auger cleaner.

The price of these tools is £96.

Extra length of boring rod, per 10 ft. length, £1 4 0.

BORING PLANT FOR FIVE HUNDRED FEET DEPTH consists of fifty 10 ft. lengths of boring rod and one swivel rod, one clay auger each 8¼, 7¼, 6¼ and 5¼ in., one flat chisel, one T chisel and one S chisel each 8¼, 7¼, 6¼ and 5¼ in., one shoe nose shell with valve and one auger nose shell each 7, 6, 5 and 4 in., two worm augers, two bell boxes, one crows foot, one bell screw, two pairs of tillers with spare screws, two lifting dogs, four hand dogs, two rod rests, one spring hook with 30 ft. of rope and snatch block, one rigger and carriage, one auger board and cleaner.

The price of these tools is	£178 0 0
Extra length of boring rod, per 10 ft. length	£1 12 0
Boring plant for 1000 ft. depth costs about	£440 0 0
Extra length of boring rod, per 10 ft. length	£2 4 0
Ironwork for shear legs	£3 0 0
Sinkers' windlass for wells up to 200 ft. depth	£12 0 0
Do. do. do. 300 do.	£24 0 0
Do. do. do. 1000 do.	£38 0 0

Lining tubes for bore holes are usually made with swelled or flush screwed ends.

PRICES OF LINING TUBES FOR BORE HOLES.

External diameter.. .. inches	3	3½	4	4½	5	6	8	10	12
Brazed and collared pipes, per foot	2/7	2/10	3/-	3/2	3/4	4/4	6/-	8/-	11/-
Swelled and screwed end ,,	1/6	1/9	2/-	2/-	2/3	2/9	3/9	..	..
Flush screw end .. .. ,,	2/4	2/8	3/3	3/9	4/6	5/8	9/4	13/6	23/-
Steel driving collars and shoes ..	13/-	16/6	20/6	25/-	30/-	38/6	50/-	75/-	120/-

The cost of packing for shipment and delivery f.o.b is 5 per cent.

HYDRAULIC MINING, as carried out in the United States of America and, to some extent, in the Australian Colonies, is represented in one of its numerous phases by Fig. 6030.

This system of mining is, in effect, as nearly as it can be done mechanically, a reproduction of the eroding and carrying power of water, which has exercised so great an influence on the configuration of the earth's surface.

Fig. 6030.

The object sought, in hydraulic mining is, to bring down and convey in the manner desired, a maximum quantity of stuff with a minimum outlay for labour and, that this object has been attained, is proved by the fact that gravel, carrying gold of the very limited value of 2d. per cubic yard has, by hydraulic mining, yielded a satisfactory profit. Various forms of "giants," or distributing apparatus, have been thoroughly tested, but experience indicates that the type illustrated gives the best result and, as a consequence, it is now generally used.

Perhaps no more daring examples of engineering work can be found than are to be seen, in California and Colorado, in the construction of reservoirs and ditches and in the mode of supporting flumes and pipe lines. These works, carried out under great difficulties, are often of the "rough and ready" order, but with few exceptions, very practical.

Not less remarkable is the ease and certainty with which the pipeman manipulates the nozzle to bring down the maximum quantity of stuff, with a minimum volume of water, and directs it to the sluices where the gold is deposited.

The work performed by the giant must evidently vary with the strata to be brought down, the head and permanency of supply of water available, and other conditions. If the supply of water is limited, or the strata—such as cement gravel—are exceptionally tenacious, it is found economical to use powder to loosen the ground and some examples will be given of the quantity of stuff washed by the giant, after blasting.

In other cases (the boulders having been disposed of over the grizzly, or otherwise,) the cement gravel comes down in masses and has to be broken up in stamp mills. These are usually provided with short amalgamating tables and the slimes are carried to the sluices to save any gold, which has not been deposited on the tables.

PRICES OF GIANTS, Fig. 6030.

Diameter of nozzle	in.	3	4	5	6	7
Do. inlet	,,	7	9	11	11	15
Price of apparatus	..	£25	£35	£45	£50	£60

The cost of deflectors for the giants ranges from £5 to £10 each.

The work performed by the giant, operating on hard ground which has been loosened by blasting, is estimated by a Colorado authority approximately as follows:—

A giant with nozzle 3 in. diameter and supplied with 100 miners' inches, (see below) from a head of 100 ft., the ground sluice being 100 inches, will wash 600 yds. per day of 10 to 12 hours. Three men are required for this work.

A giant with nozzle 6 in. diameter and worked by 4 men, the supply of water being 700 miners' in. from a head of 150 ft., will wash 3000 cubic yds per day. The sluice area must of course be in proportion with the larger output.

THE SLUICES (sometimes called "launders") consist of long open troughs constructed of timber, paved with stone or boulders and provided with riffles, under currents, and other contrivances for arresting and retaining the bullion. The maximum deposit of this depends very much on the velocity and uniformity of the current in the sluices.

It follows, therefore, that great care should be exercised in laying the sluices at the incline, in the arrangement of riffles, and under currents, and for amalgamating, in the manner most suitable for arresting the gold in the wash dirt. Also that an ample area of sluices is provided, so that they need never be forced or overcrowded. As is well known, the distance to which leaf or float fold is carried is in proportion with the velocity of the stream and, in connection with this detail, the Writer may say that he has seen well paying mines, where a large value of gold escapes which would be saved, if the length of sluices and velocity of current were suitable for the character of the wash dirt.

According to a well established rule, based on observation, if the gravel consists mainly of large and angular pieces, the gold may be expected to be so, but if it is smooth and more or less polished, the gold will (almost certainly) be in fine particles, round or leafy in shape.

It is also well to bear in mind that, the specific gravity of the strata worked in hydraulic mining varies from about 75 lbs. to 100 lbs. per cubic foot and the carrying power of water at different velocities is approximately as follows:—

Thirty feet per minute slightly moves fine sand.
Forty feet do. moves fine gravel.
One hundred and twenty feet per minute moves pebbles up to 1 cubic inch.
Three hundred and twenty feet do. do. boulders up to 3 or 4 inches in section.

THE PIPES conveying the water from the reservoir to the giants (seen on the right of the engraving) are usually made of wrought iron, or steel, and if made of slightly different diameters they will "nest" and so bring the measurement to approximate to the dead weight. In some cases, however, the difficulties in transport have been so great that it has been found necessary to send the plates to the mine and bend and rivet up the pipes on the spot.

MINERS' INCH.—There are slight variations in this measure in different localities, but that contemplated in the foregoing figures, is the quantity of water which will flow through a hole 1 in. square cut clean in a plank 1 in. thick, and 6 in. below the constant level.

Approximately, this is equal to 1.6 cubic ft. per minute, or about 95 cubic ft. per hour.

MINE PUMPS for metalliferous mines. The inflow of water, if intermittent or inconsiderable, may often be kept under control by baling at intervals with the ordinary kibbles, or by buckets with bottom valve specially constructed for the purpose.

If, however, the quantity exceeds that which can be conveniently dealt with by these means, the question as to the most suitable pumping machinery deserves careful consideration.

Different types of machinery for these purposes are fully dealt with in the section devoted to "Pumping Machinery" and it will only be necessary, here, to refer to those especially adapted for mining purposes.

In many—perhaps in most—cases every purposes is answered by mine pumps of the usual type (see Fig. 6031), and the approximate cost of these will be found in the tables which accompany the illustration. These pumps may be worked from a counterbalanced quadrant (or bob lever) connected with a pumping arm on the drum shaft, as indicated in Fig. 6031; but, if pumping and winding must be carried on simultaneously, it is very much better to have a separate engine to drive the pumps.

In connection with this branch of the subject, attention may be directed to the fact that the tendency in recent years—constantly increasing—is, to fix the pumps, driven by steam or other motive power, as near as possible to the sump, and deliver at the surface in one lift. Any difficulty or inconvenience caused by the pressure of steam in the mine is completely overcome by the use of compressed air or of a pump similar to that illustrated by Fig. 6033 which is driven by an electric motor supplied with current generated at the surface, by a hydraulic pump Fig. 6032, or by direct acting steam pumps as illustrated and described in Section III.

Engravings and descriptions of pumps suitable for working by steam or animal power, and for raising a moderate quantity of water from depths not exceeding about 300 ft., will also be found in Section III.

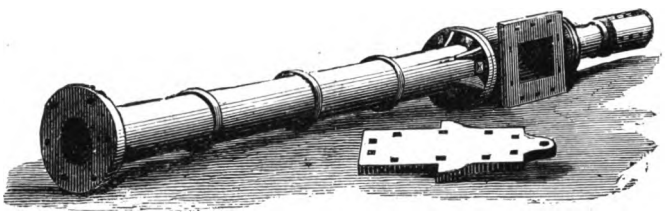


Fig. 6031.

MINE PUMPS.—The type of working barrel with door piece for access to the valve seat and valve, and strong suction piece or wind bore is indicated by Fig. 6031. The rest of the pump consists of cast iron (or, if preferred, wrought iron) pipes with faced flanges, bolts, &c.

The pumps are complete with clacks, spears, &c., up to the connection with the pumping quadrant.

THE PUMPING QUADRANT is of the form shown in Fig. 6034 and is constructed in wrought iron with steel gudgeon, &c., complete.

PRICES OF MINE PUMPS, &C, 4 IN. DIAM. AND 3 ft. STROKE.

Depth of mine .. .. .. feet	200	300	400	500
Price of pumps	£76	£92	£102	£137
Approximate weight .. .. tons	4	5½	6½	9¾
Price of quadrant piece	£30	£35	£40	£45

PRICES OF MINE PUMPS, &C., 6 IN. DIAM. AND 3 FT. 6 IN. STROKE.

Depth of mine .. .. .. feet	200	300	400	500
Price of pumps	£105	£132	£158	£193
Approximate weight .. .. tons	5¾	8¼	10½	14½
Price of quadrant piece	£38	£47	£54	£63

PRICES OF MINE PUMPS, &C., 8 IN. DIAM. AND 4 FT. STROKE.

Depth of mine .. .. .. feet	200	300	400	500
Price of pumps	£142	£188	£218	£260
Approximate weight .. .. tons	6½	10½	14½	19
Price of quadrant piece	£54	£64	£73	£80

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

HYDRAULIC MINE PUMPS.—Fig. 6032 illustrates a useful and perfectly reliable application of hydraulic force, devised by Mr. Moore, for replacing reciprocating pump rods or "spears," by fixed pipes carrying a column of water which acts on the plungers of the mine pump and causes the drainage water to be forced to the surface.

The appliances to effect this consists of a pair of hydraulic pumps driven by steam or other power at the surface; the delivery end of each of these pumps is connected by the power pipes (as shown in the engraving) with the mine pump plungers, in such a manner that they work in

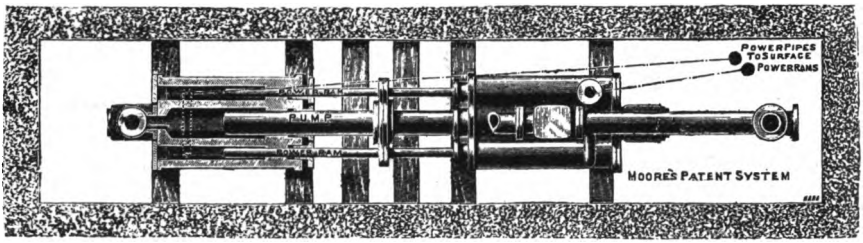


Fig. 6032.

accord with those at the surface and maintain the necessary continuous action, without the intervention of the balance bob, pump rods, guides, &c., hitherto indispensable for unwatering a mine by machinery fixed at the surface.

No skilled labour is required beyond that of an ordinary engine driver, and the proportions of the driving machinery and of the mine pumps, pipe connections, &c., are easily varied to suit any conceivable conditions.

The mine pumps may be fixed at any angle or in any position and work just as well in places inaccessible to pumps of the usual construction, as in a vertical shaft.

The power pipes may be carried down alongside the rising main, or where else may be convenient. In any case these fixed pipes must evidently occupy much less space than moving pump spears and admit of being carried through tortuous workings, very limited in sectional area, where it would be difficult, or impossible, to use a pump of any other type.

The loss in useful effect, as in other modes of utilizing hydraulic power, is limited to that due to friction and is so small that it need not to be considered; obviously also, no inconvenience can be caused by the condensation of steam, loss of power by radiation, &c. It will also be seen that a head of water as usually required for hydraulic pumps, need not be provided for these.

Another meritorious feature of this system of pumping is that the one set of power pumps at the surface will, if required, work several pumps at the same time at various shafts and at different depths.

Pumps of this construction are in successful operation from 4 in. diameter and 3 ft. stroke, double acting, working through a distance horizontally of about 3000 ft., with a lift vertically of 420 ft., to 14 in. diameter and 5 ft. stroke, through a distance of about 1800 ft. with a vertical lift of 600 ft.

These examples are given not—in any way—as indicating the limits of this system of pumping because it will be evident that the strength of the pumps and connecting pipes can be varied to suit almost any conceivable conditions.

The following approximate prices are for pumping machinery equal to raising water a vertical height of 400 ft. through a distance of 3000 ft., and they comprise:

The surface pumps with their power rams, the double acting mine pumps and all necessary valves complete, ready for coupling the connecting rod of the engine with the surface pump crosshead; but they do not include any pipe connections between the surface and mine pumps or engine power for driving. Both these items must be determined in each case, but they are easily estimated and—with the data now given—the total cost of the plant, fixed and ready for work, can be ascertained nearly enough for all practical purposes.

The details required for estimating the cost of hydraulic mine pumps are:—

The **depth**, vertically, from the surface to the mine pump.

The **distance** from the surface pump to the mine pump.

The **quantity** of drainage water to be raised in a given time.

The **pressure** of steam (if any) available for driving the hydraulic pumps at the surface.

If it is desired to drive the last named pumps by turbine, water wheel, gas or oil engine, electric or other motor, this should be stated together with the speed, in revolutions per minute, of the shaft from which it is proposed that motive power shall be transmitted.

PRICES OF HYDRAULIC MINE PUMPS, Fig. 6039.

Diameter of pumps	in.	4	6	7	8	10	12	14
Stroke ,, ...	ft.	3	3	3	4	4	4	5
Price of pumps	..	£115	£175	£230	£297	£345	£400	£625

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

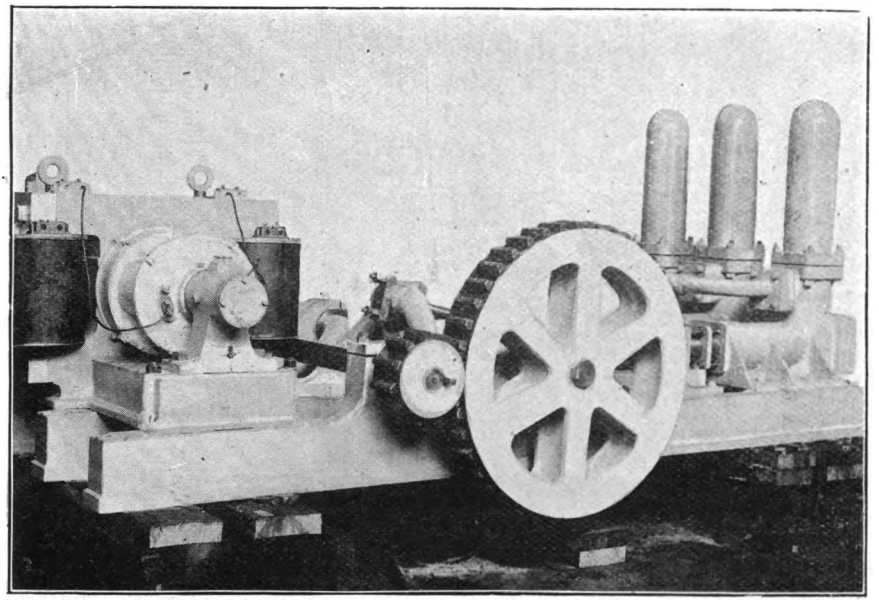


Fig. 6033.

TREBLE BARREL MINE PUMPS.—The engraving Fig. 6033 illustrates an electrically driven three throw pump which delivers 8400 gallons per hour through about 3500 feet of rising main to a height of 1350 feet.

This type of pump is made for almost any duty in regard to quantity and height of lift, and is adapted to be worked by belt or rope, without intermediate gear, or—as in this case—by its own motor and intermediate gear.

The advantage derived from the use of three throw pumps, as is well known, is that the velocity of flow is much more uniform than is attained by pumps of any other construction.

If floor space is limited, the pumps can be fixed vertically or at an angle and the bed plate made of the dimensions and strength necessary for carrying the motor, as shown in the illustration.

The pump barrels, valve chests and air vessels are made of hard close grained cast iron and are tested to double the working pressure. The connecting rods are of steel and all bearings, valves, seats, &c., are made in hard gun metal carefully fitted and finished.

ELECTRICALLY DRIVEN PUMPS are made as above illustrated and described and the prices of these, as well as of pumps driven by belt, &c., are given in the following list.

As already indicated these pumps are made of any proportions required and the cost of them will be furnished on receipt of information relative to the conditions to be fulfilled.

PRICES OF THREE THROW MINE PUMPS, Fig. 6033.

Height of lift .. .. feet	200	500	1000	400	800	1200
To pump gallons per hour ..	1400	1400	1400	4050	4050	4050
Price of pump without motor ..	£57	£62	£70	£125	£138	£159
Ditto with electric motor	£105	£162	£212	£281	£372	£432
Hermetically enclosing armature	£25	£28	£30	£35	£60	£65

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

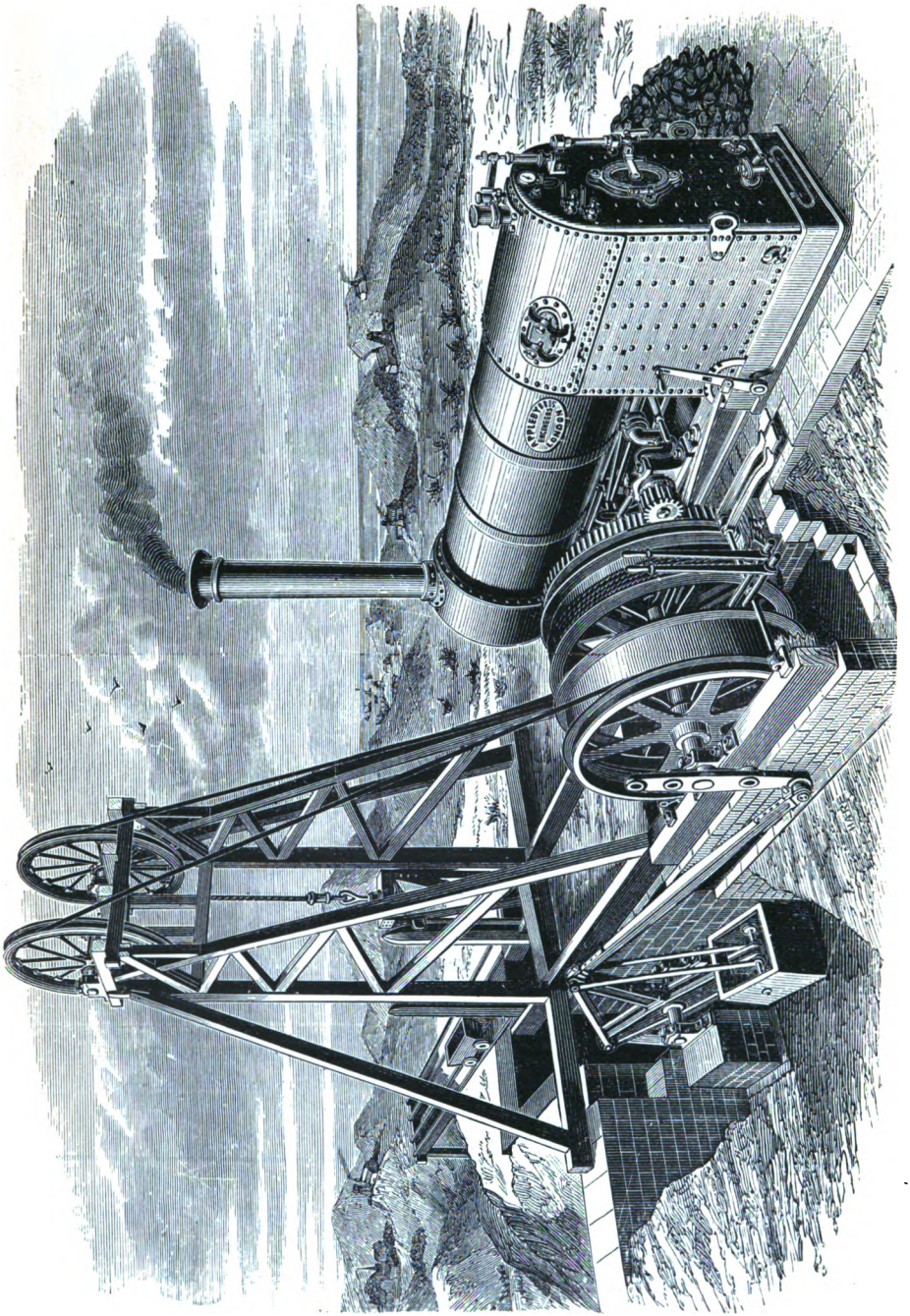


Fig. 6034.

WINDING ENGINES for metalliferous mines are rarely required to work at the speed or to the depth necessary for raising coal, and the types illustrated by Figs. 6034 to 6036 may be regarded as fairly representing the types in general demand for the first named purpose. But as these and other arrangements of winding machinery are fully described under the head of "Hoisting Machinery," the following brief descriptions and approximate prices may probably suffice for purposes of estimate.

As regards the latter, every mining engineer will recognise the impossibility of making correct estimates of cost without accurate data in regard to the conditions to be fulfilled. These vary so widely that the engineer will doubtless make the allowances in the following estimates—plus or minus—which the cases he has under consideration may require.

These engines have ample proportions, the working parts are well finished and all can be provided with a pumping arm if that mode of un-watering the mine is considered desirable.

THE WINDING ENGINES, pit head gear, pumping and other arrangements connected with the work illustrated by Fig. 6034, were designed and constructed by the Author's firm and have been in constant work for many years.

The engines may be erected for work on timber or (as shown) on masonry foundations, or even on solid ground. But an excellent and useful form of foundation is provided by a strong wrought iron tank which serves to carry an ample supply of feed water. The cost of this, and an injector as an auxiliary to the donkey pump which is supplied with the engine, will be found below.

The boilers are of the locomotive type, constructed of mild steel; the longitudinal seams are double rivetted and all rivets are closed by hydraulic pressure. Each boiler is tested by hydraulic pressure to 220 lbs. per square inch and provided with the highest class of steam, feed water and furnace fittings.

Steel is largely used in the construction of this machinery and, if winding from different depths is required, the drums are made of the diameters suitable for those different depths.

If the engines are required for winding only, the drums are keyed on the shaft and this is contemplated in the estimates of cost. If the engine is required to drive other machinery occasionally, the pinion on the crank shaft can be drawn clear of the wheel on the drum spindle for power to be transmitted by a belt, off the fly wheel. But if the engine is to be used for pumping, as well as for winding, a separate pumping shaft must be provided, or the drums must be loose on the shaft and connected to it by steel clutches; the extra cost of these will be found in the list.

THE PUMPING ARM is made of wrought iron or cast steel and keyed on the drum shaft; the crank pin is of steel and is turned to fit any of the holes which are provided in the arm for varying the stroke of the pump.

PRICES OF WINDING ENGINES, &c., Fig. 6034.

Engines, nominal horse power ..		12	14	16	20	25	30	50
Diameter of drums	inches	48	48	48	54	60	60	72
Speed of rope per minute ..	feet	460	460	460	500	500	500	600
Load lifted vertically	cwts.	12	13	16	23	29	36	48
Do. hauled up 1 in 25 ..	tons	10	13	16	19	25	31	42
Do. do. on level	,,	33	44	53	64	80	100	137
Price of engine with one drum ..		£405	£440	£475	£555	£640	£760	£1270
Do. do. do. two do. ..		£445	£480	£515	£600	£710	£830	£1400
Loose drum and clutches ..	each	£11	£11	£12	£12	£14	£15	£25
Price of tank foundation		£50	£60	£65	£70	£80	£90	£140
Extra injector and fittings		£8	£8	£9	£10	£11	£12	£15
Do. enlarged fire box		£8	£10	£12	£16	£20	£25	£30
Do. for pumping arm		£9	£9	£10	£11	£12	£13	£18

The cost of packing for shipment and delivery f.o.b. varies according to destination, &c., but may be assumed to cost from 5 to 10 per cent.

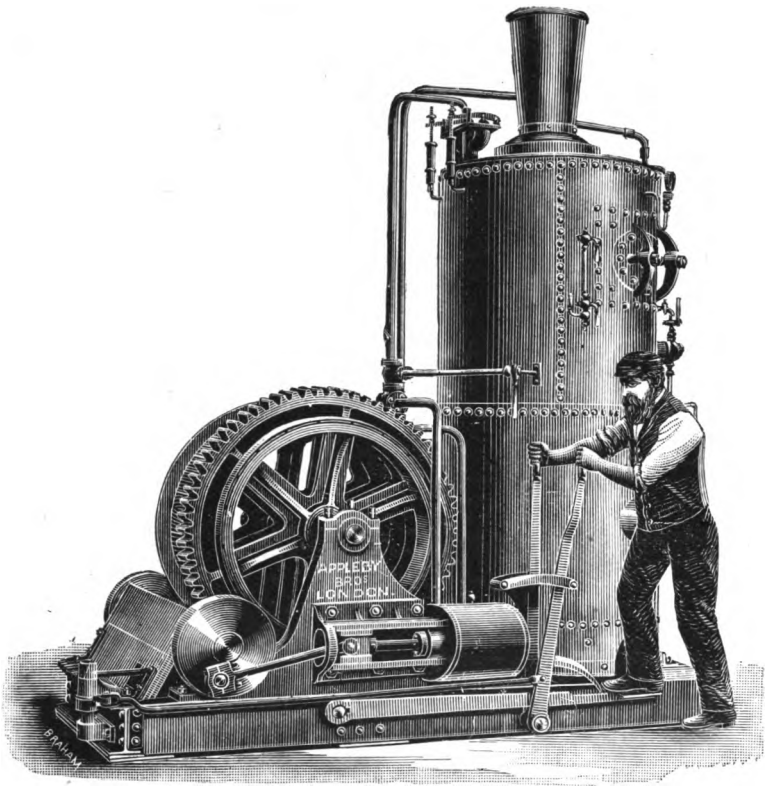


Fig. 6035.

WINDING AND HAULING ENGINES, of the construction indicated in Fig. 6035, occupy a minimum space and are made complete with vertical boiler, as shown, or without boiler, to suit situations where a different source for steam supply is preferred.

If the arrangement indicated in Fig. 6035 is convenient, the boiler and engines are mounted on a bed plate and carried on wrought iron girders, or on a tank, so that little or no expense is incurred in making foundations.

The prices will be found for each of the combinations in which these engines are usually made; if others are required they will be subjects for special design and estimate.

PRICES OF WINDING AND HAULING ENGINES, Fig. 6035.

Dimensions of twin cylinders .. .. inches	6 by 10	8 by 12	10 by 14	12 by 16
Diameter of drum or drums	2ft. 5in.	3ft.	3ft. 6in.	4ft.
Price with boiler and two drums	£264	£353	£440	£566
Weight .. .. tons	5	6¾	9½	13
Price with boiler and one drum	£254	£334	£413	£555
Weight .. .. tons	4¾	6½	8½	12
Price without boiler, two drums	£165	£215	£260	£346
Weight .. .. tons	3	4	6¼	8¾
Price without boiler, one drum	£155	£196	£233	£335
Weight .. .. tons	2¾	3¾	5¼	7¾
Extra for steel gearing	£8	£17	£27	£33
Extra for wrought iron drums	£20	£28	£33	£40

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

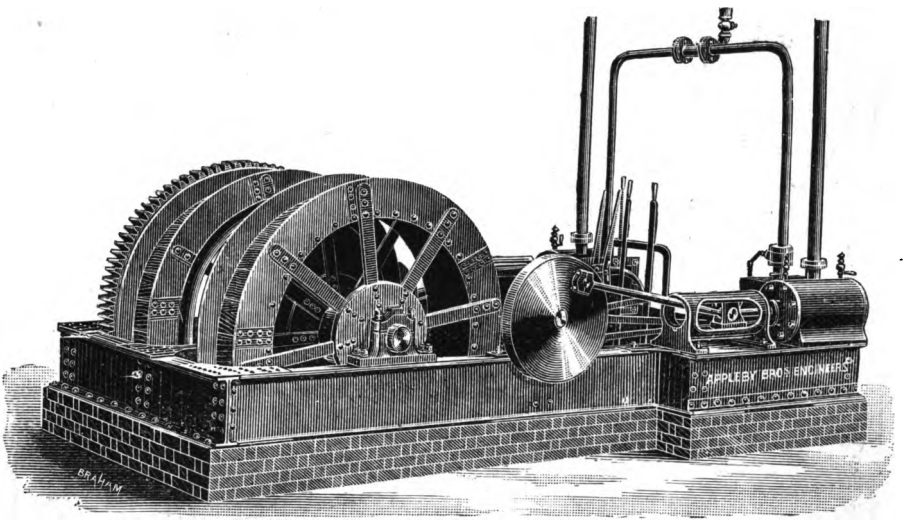


Fig. 6036.

WINDING OR HAULING ENGINES, Fig. 6036, shews a type of horizontal winding gear, specially adapted for use in localities where lightness of parts is necessary owing to difficulties of transport. To attain this object the frames are built up in wrought-iron or mild steel, so that the weight and bulk of parts may be reduced to a minimum, these being properly marked for re-erection at destination.

Where the conditions above referred to do not exist, the engines and gear are mounted on a massive cast-iron bed plate. This reduces the cost from 5 to 10 per cent., but the wrought-iron construction shewn and described is almost invariably preferred.

As will be seen in the engraving the arrangement is compact, all parts are accessible for examination or repair, and the levers are conveniently placed, the brake lever (not shown) being generally carried behind the cylinders. The engines are carefully balanced and fitted with case-hardened reversing link motion, all gearing is flanged up to pitch line, and all working parts are thoroughly well fitted and finished.

The double drums loose on shaft, are bushed with gun metal, the clutch of each drum being connected to one lever, so that they may be worked independently or together; the single drums consist of two cast-iron cheeks with wood lagging.

The boilers referred to in the list of prices are of the locomotive type, represented in Fig. 6034, and are complete with chimney, and all fittings for steam and feed water, as well as the furnace mountings, and pipe connections for a moderate distance between the boiler and engine.

PRICES OF WINDING AND HAULING ENGINE, Fig. 6036.

Dimensions of twin cylinders	inches	6 by 10	8 by 12	10 by 14	12 by 16
Diameter of drum or drums		2ft. 5in.	3 ft.	3ft. 6in.	4 ft.
Maximum revolutions per minute		160	150	150	140
Price of engine with one drum		£165	£215	£245	£350
Weight	tons	3½	4½	6½	8
Price of engine with two drums		£190	£240	£288	£385
Weight	tons	3½	4¾	8	9¼
Extra for steel gearing		£10	£19	£30	£37
Extra for wrought iron drums		£22	£28	£36	£44
Price of boilers		£75	£93	£125	£156
Approximate measurement ..	cubic feet	150	190	280	350

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

HORSE POWER WINDING GEAR (not illustrated).—Of all the means of raising ore from mine shafts, the old fashioned horse power "whim" is still popular, and certainly it is the simplest; it is quite suitable for shafts of medium depth, and is usually put together at the mine.

Another type of winding gear for mines of medium depth consists of an ordinary horse gear driving a spur wheel, keyed to the barrel shaft, through a spur pinion, the mine frame work, with tackle for leading the rope down the shaft adit being generally supplied at destination.

The gear is suitable for use with hemp rope, wire rope, or chain, and the price of the ironwork complete, comprising strong pulleys and snatch block, rope drum, spur driving gear, horizontal shaft with gun metal bushed bearings, clutch and lever, engaging and disengaging tackle, with strong horse gear, pole, hook and whippletree, is £80.

TIMBER PIT HEAD GEARS of the type Fig. 6034 are usually constructed at the mine. The ironwork for them consists of carefully balanced rope pulleys with V groove in the rim, turned steel spindle, strong pedestals for spindle fitted with hard gun metal bearings and lubricators, and the wrought iron straps, knees, &c., for the framework.

METALLIC PIT HEAD GEARS (not illustrated) are built of wrought iron or steel girders resting on strong cast or wrought iron foundation plates.

The backstay (on the engine side) is lattice braced, and a wrought iron ladder is provided, usually on the front supports, to give access to a platform surrounding the grooved pit head pulleys, for lubrication, &c.

PRICES OF IRONWORK FOR PIT HEAD GEAR.

Engines, nominal H.P.	12	14	16	20	25	30	50
Prices of iron work for timber ..	£30	£33	£35	£40	£45	£50	£70
Do. metallic pit head gear complete	£120	£130	£135	£140	£170	£180	£195

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

SAFETY LINKS FOR MINING ROPES are designed to hold the cage or bucket suspended from the stop which is struck in cases of overwinding.

The links are made of steel, and are an excellent safeguard against accidents arising from the case referred to.

PRICES OF SAFETY LINKS.

Working load .. .. tons	2	4	5	8	10
Price of Links for one rope	£8	£11	£13	£18	£21

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

PATENT AUTOMATIC DETACHING HOOK, for mine shafts, furnace and other hoists. Amongst the numerous devices for ensuring the safety of miners in cases of overwinding, that illustrated by Figs. 6037 and 6038 is perhaps the most simple and efficient. Fig. 6037 represents the hook in working order, and it remains in that condition so long as the lifting rope or chain remains in tension. But in case of overwinding—arising from accident in some cases, or carelessness or incompetence in others—so soon as the hook has passed the catch plate which is attached to the pit head (or other) frame, the two plates which hold the shackle open in opposite directions and assume the positions indicated in Fig 6038. The lifting shackle is thus released and the cage safely suspended until the shackle is brought back and re-adjusted. This is easily and quickly done by one man, and the cage is then ready to lower in the usual manner.

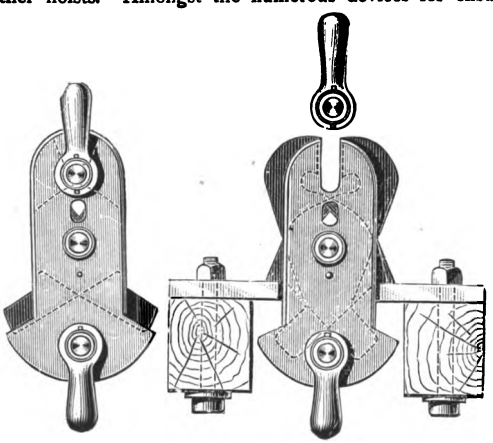


Fig. 6037. Fig. 6038.

A large number of these hooks are in constant use and have been the means of saving many lives and preventing much injury to property.

The hooks are made of best Yorkshire iron and are carefully tested before leaving the works: the capacity given in the following price list is that recommended for the actual working load, but in view of the immense strain that would result from the momentum of the cage against the pit head gear, it is recommended that a size or two larger should be specified; or better still a hook with a breaking strain equivalent to that of the chain or rope suspending the load: in all cases three hooks are necessary for each shaft, that is two in use and one to regularly change for the purpose of examination, cleaning, &c.

PRICES OF AUTOMATIC DETACHING HOOK, Figs. 6037 AND 6038.

Capacity, tons	3	4	5	6	7	8	10	12	15
Price each	£13 10	£15 10	£17 10	£19 10	£21 16	£23 10	£25 10	£27 10	£30

PATENT SAFETY CAGES.—This invention consists of appliances attached to the cage and close to the timber or rope guides, but which cannot come into contact with them so long as the cage is in its normal position, *i.e.*, safely suspended from the lifting rope or chain. If however this breaks, gripping appliances, suitable respectively for timber or rope guide, come into operation and hold the cage until a new rope has been attached or other assistance obtained.

The gripping gear can usually be sent, ready for fixing to existing cages, if proper details are given of the dimensions and construction of the cages and of the timber or rope guides, the total weight, &c.

The cost of the gripping gear ranges from £10 to £25 per cage, and full information relating to above-named matters should be sent with the order.

MINING CAGES AND CAGE PROPS, constructed of steel frames with wrought iron floor, are usually of the internal dimensions given below, but they can be built to suit trucks of other dimensions. They are complete with roof and chains, with coupling ring for connection with the lifting rope, and with appliances for preventing the trucks from moving laterally.

The props for holding the cage in position at the pit's mouth are made of steel, and are raised or lowered simultaneously by the movement of a lever alongside the drawing headstocks.

PRICES OF MINING CAGES AND PROPS.

Length of cage	4 ft. 5 in.	4 ft. 9 in.	5 ft. 6 in.
Width ,, ...	2 ft. 6 in.	3 ft.	3 ft.
Height ,, ...	5 ft. 6 in.	5 ft. 6 in.	6 ft.
Price of cage	£22	£26	£28
Price of props	£9	£10	£11

The cost of packing for shipment and delivery f.o.b. is 6 per cent.

MINE CAGES.—In addition to those referred to in the preceding table, may be mentioned:—

Three deck cages for 3 trucks or tubs.
Do. 6 do.
Two deck cages for 2 do.
Do. 4 do.
Single deck cages for 1 do.
Do. 2 do.

But plant of this kind must always be designed and made to exactly suit the conditions peculiar to each case, and estimates of cost can only be made when the necessary details have been furnished.

WATER BALANCE TANKS with attachments for hauling and arranged to be filled and emptied automatically must also be subjects for special consideration and estimates.

ADJUSTABLE TRUCK CARRIAGE FOR INCLINES.—

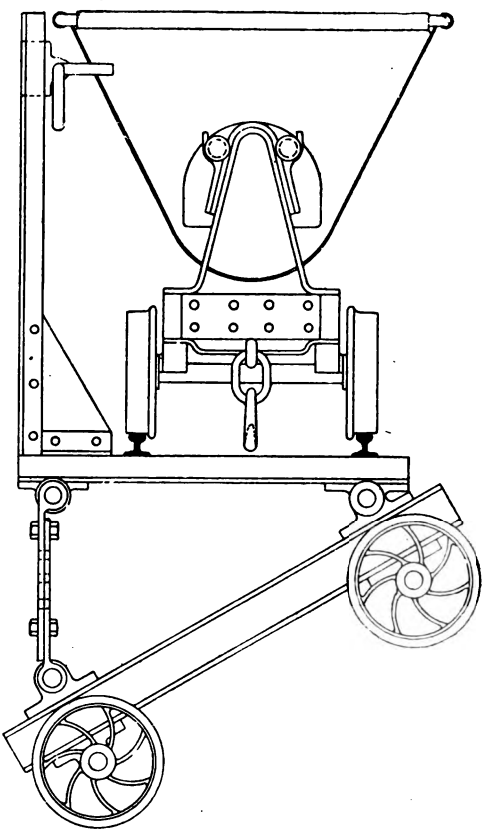


Fig. 6039.

The arrangement indicated in Fig. 6039 has been designed by an eminent mining engineer to avoid the necessity for constructing a special carriage for each gradient of surface railway or mine adit.

It will be seen that the angle of the platform can be instantly adjusted to suit any gradient, by simply changing the position of the bolts in the plates which connect the truck platform with the under carriage.

The truck platform is bolted to strong T irons and the under carriage, wheels, axles, &c., are of steel, and are provided with draw gear for a train to be formed and for hauling by wire rope or chain.

A standard with catch is fixed to the rear end of the platform to hold the truck in position in case of obstructions on the line.

INCLINE GEARS driven by power, or controlled by water balance tank, or to work by gravitation. Prices will be given upon receipt of the necessary data to form an estimate.

CAST STEEL ROLLERS FOR INCLINES, groved or plain pulleys, parallel or taper drums, guides, &c. of all dimensions and with or without spindles and carriers. Prices will be given upon receipt of the necessary data to form an estimate.

TRUCK or TRAM WHEELS in cast steel, cast or chilled iron or with wrought iron bodies and steel tyres. Axles, pedestals, axle boxes, hornplates, springs and other fittings for wagon work. Prices will be given upon receipt of the necessary data to form an estimate.

PRICES OF ADJUSTABLE CARRIAGES, Fig. 6039.

Gauge of rails .. .. ins.	16	18	20	24
Ditto .. .. centimetres	40	45	50	60
Price of carriage	£8	£8 10	£9	£9 10

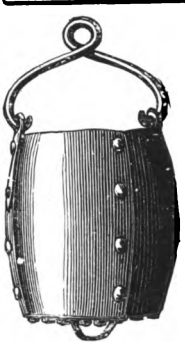


Fig. 6040.

IRON WATER CAGES for unwatering mines by winding, with automatically acting valves for charging below and for discharging at the surface Prices will be given upon receipt of the necessary data to form an estimate.

MINE KIBBLES AND SKIPS for raising ore, water, &c., are generally of the type illustrated by Fig. 6040, but the contractors' turnover skip illustrated and described in Section V., is frequently used for these purposes; the kibbles are constructed of mild steel plates and provided with handles as shown and are made of the sizes and shapes required.

PRICES OF MINING KIBBLES, Fig. 6040.

Description of kibble ..	Winze	Derry	Horse-whim	Steam-whim
Diameter at mouth ..	12½ in.	16¼ in.	20 in.	22 in.
Do. at centre ..	15 in.	18½ in.	22 in.	26 in.
Do. at bottom ..	11 in.	15 in.	16 in.	18 in.
Depth	15 in.	16 in.	24 in.	30 in.
Price, each	£1 5	£2 5	£3 10 0	£5 0 0

The cost of delivery f.o.b. is about 3 per cent.

WIRE ROPE OVERHEAD TRAMWAYS illustrated by Fig. 6041 and Fig. 6042, are used with great advantage for conveying materials in localities where the contour of the country, the cost of construction, or other considerations do not admit of making a road or railway.

The cost of transport by rope tramway, including wages, interest on capital, depreciation and all minor working expenses ranges from 2 pence (or less) to 6 pence per ton per mile. The rope line may be carried to form any curve and at almost any gradient, so that obstacles to other modes of transport are easily overcome as, for instance, in conveying materials from the mine or works, or to a railway station or jetty for shipment, or from one manufacturing department to another, over buildings, and depositing them where they are required for use or treatment without further handling, also in many other cases where rope way transport offers facilities which neither road or railway can give.

The two systems in general use may be broadly defined as "the travelling rope" and "the standing (or fixed) rope."

Both modes of working are largely employed and both give perfectly satisfactory results under the conditions proper for each; but the travelling rope way, although rather more costly than the fixed rope, is perhaps more generally used.

THE TRAVELLING ROPE SYSTEM, Fig. 6041, is based on the use of a steel wire rope, of great strength and durability, travelling at a speed (usually) of about 350 ft. per minute which, by its forward motion carries the suspended load as indicated in the engraving.

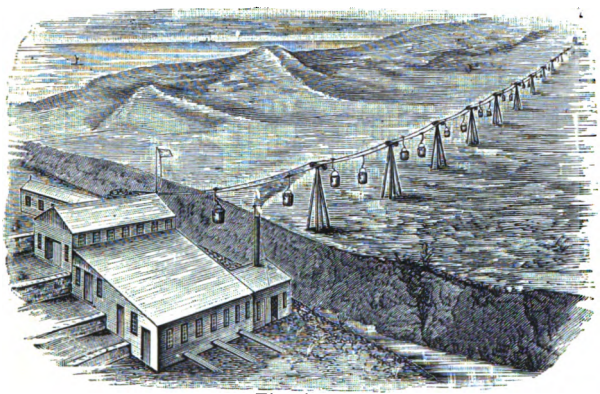


Fig. 6041.

The suspended load may range from about 1 cwt. to 5 cwts. and the form of carrier is varied to suit the materials to be transported; those for minerals are usually cylindrical or square buckets which are emptied by a boy anywhere along the line or at the discharging station; or the metallic appliances for automatically filling the buckets at the loading station and discharging them at the other end of the line or at any point desired can be provided at a cost of from £60 to £70. For piece goods, opening boxes are provided, slings for casks or bags, one form of hanging cradle for cane carrying, another for sacks or casks, and so on.

In all cases the carriers are suspended from iron or steel frames mounted on wheels grooved to suit the diameter of the rope, and arranged to pass freely over the pulleys and tressles which support the carrying rope at convenient intervals, as indicated in the engraving.

The supports, for level ground are usually made of timber about 15 ft. high and fixed at intervals of about 150 ft., but the distance between them may be extended to 500 or 600 ft.; the height, and distance apart must necessarily be arranged to suit the local conditions and, it is almost always more convenient and economical to construct these supports on the spot.

If however, for any reason, metallic supports are necessary, estimates for them will be prepared on receipt of details, such as the heights required, the distances between the supports, the nature of the ground, &c.

Whatever may be the capacity of the buckets or other form of carrier, they can be conveyed and delivered at the rate of about 200 per hour and, if desired, the trollies can be run on to a fixed or shunt rail and—when emptied—be passed on to the travelling rope without interfering with its continuous motion. The cost of supports is not included in the accompanying approximate estimates.

The following notes may assist in determining questions relating to the adoption of this mode of transport, and save much time in correspondence.

The distribution of loads mentioned in the accompanying table—or within 20 per cent. thereof—will be found convenient and are recommended as economical, unless good reasons exist for deviating from them.

Carrying capacity of line in tons per hour..	5	10	20	30
Approximate weight in each carrier lbs.	100	130	175	400

The rope way will naturally be straight, if that is possible; if it is not, deviations from the straight line should be produced by angles rather than by curves.

The motive power required for hauling over lines on the level or on rising gradients should, by preference, be at the delivery end of the line but, if that should present difficulties or even inconvenience, it may be at any other point.

If the loads are to traverse a down grade of not less than about 10 degrees (1 in 36) no motive power is required and an efficient brake is provided which automatically controls the speed of traverse over the steepest gradients.

Approximate estimates of cost for lines of different carrying capacities will be found further on but, if the details about to be referred to are accurately given, the value of the materials will probably be less than the figures given in these estimates.

The details required are:—

The kind of materials and the total quantity to be carried in a given time.

The total length of line with plans and sections of the ground showing the gradients and the number and degrees of angles (if any).

Whether steam or other driving power is required or, if not, what is the speed of the motor shaft and how much power is available.

From the foregoing, it will be seen that the cost of supports for the ropes, the timber frames for the terminal and tension gears, the driving power, &c., cannot be estimated without data of the kind last referred to, but it may be assumed, in making approximate estimates, that supports averaging about 15 ft. high will cost £4 to £5 each and that usually, about 30 of them will be required for each mile of rope way.

PRICES OF MATERIALS FOR ROPE TRAMWAYS, Fig. 6041.

Carrying capacity .. .. tons per hour	5	10	20
Price of rope, pulleys and rolling stock for line not exceeding 1 mile, driving and tension gears and shunt rails	£360	£580	£750
Price of rope, pulleys and rolling stock for line not exceeding 3 miles, driving and tension gears and shunt rails	£450	£730	£920
Price of angles for any degree of deviation	£25	£35	£45

The cost of packing for shipment and delivery f.o.b. varies from 5 to 7½ per cent.

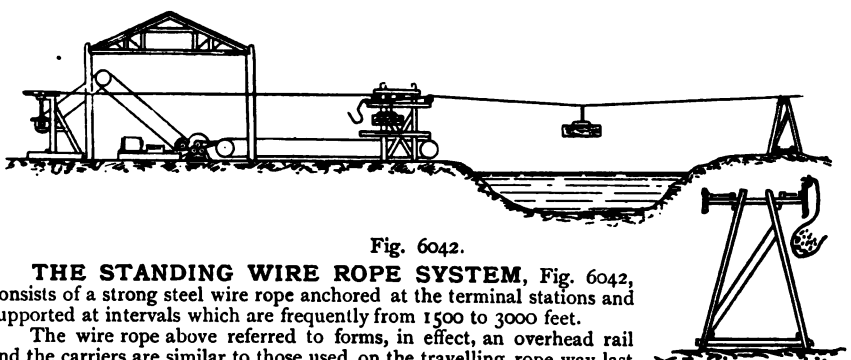


Fig. 6042.

THE STANDING WIRE ROPE SYSTEM, Fig. 6042, consists of a strong steel wire rope anchored at the terminal stations and supported at intervals which are frequently from 1500 to 3000 feet.

The wire rope above referred to forms, in effect, an overhead rail and the carriers are similar to those used on the travelling rope way last described; but in this case they are hauled by a light flexible steel wire rope when working on the level or on an ascending grade, or they are checked by the hauling rope when traversing a falling gradient.

This system of transport, but with different materials, is of very ancient date and for it little is required beyond two fixed ropes, two light hauling ropes and the carriers.

If materials are transported over a gradient with sufficient fall, the descending load will haul the empty carrier. But even if the line is on a level or with an ascending grade for the load, the friction caused by the rolling load is very small and but little power is required for hauling; the wear and tear also is low.

This type of rope way can be laid in a series of inclines of almost any length or gradient and the cost is nearly always less than that of a travelling rope way, so that the foregoing approximate estimates of the cost of these, will be ample for the system under consideration.

HAULAGE BY WIRE ROPE.—The two modes of haulage in general use are those known as the "Tail Rope" and the "Endless Rope" system.

The former is adopted where the gradients are irregular and there are branch lines, whilst the latter (the endless rope) is best adapted for lines which are comparatively level and have no very sharp curves. The ropes travel at a speed of about 6 miles per hour and are supported at intervals by rollers which are a little above rail level.

A third system in which four to six trucks are clipped to a rope travelling immediately above the trucks is sometimes (but rather exceptionally) used.

The prices for the materials required for rope haulage by any of these systems, exclusive of, or including trucks or other accessories, will be sent on receipt of information in regard to what is required.

TRANSMISSION OF POWER BY WIRE ROPE is adopted with great advantage where cheap motive power—such as that yielded by a turbine or other motor—is required to be transmitted to a distance.

The appliances for this purpose are very simple and consist of a high speed rope from a grooved pulley driven by the motor, and carried on similar pulleys which are supported on trestles fixed at intervals, the distances between these supports being regulated, largely, by the configuration of the ground.

By this means a rope of little more than ½ an inch diameter transmits 50 horse power to almost any distance, greater powers or exceptional conditions as regards distances between supports requiring ropes of larger diameter.

Many instances can be cited in which this has been done with excellent results, but one, in which the appliances were designed and made by the Author's firm, is exceptional and worthy of record.

The circumstances were as follows: An enormous quantity of lean ores, slimes, &c., had been tipped over what was eventually found to be the only remaining good paying ground and, to work this, it was necessary to remove the above named debris. It was found that this could be treated to a profit but, that at the site where the dressing floors must be, it would be difficult to fix the dressing plant and bring fuel, water, &c., to the engines.

In order to meet these difficulties it was decided to transmit power, by wire rope, from an existing disused engine on the other side of the ravine. This project was carried out with the result that the ore and debris, when treated, yielded a satisfactory return, and the mine was thus placed in a condition to resume the payment of dividends.

The principal data required for the preparation of estimates is: the speed of motor and the power to be used: the distance from the motor to the point where the power is required: the maximum distance between supports for rope.

FLEXIBLE STEEL WIRE MINE AND HAULING ROPES are made from crucible steel of special quality and subjected to test in the process of manufacture. The "working load" is about one eighth of the breaking strain and includes the total maximum weight to be hauled, to which must be added—for vertical lifts—the weight of the rope itself.

PRICES OF FLEXIBLE STEEL MINE ROPES.

Approximate diameter in.	½	9/16	⅝	¾	⅞	1	1⅛	1¼
Do. weight per yd. lbs.	2¼	1⅓	2	2¾	4	5	6¾	9
Do. working load cwt.	15	16	22	32	46	56	68	89
Do. price per yard ..	4d.	8d.	9½d.	1/1	1/6	2/2	2/9	3/8

The cost of wrought iron or steel thimbles, and splicing in, varies from 3/6 to 6/6 each.

The cost of packing for shipment in strong canvas and delivery f.o.b. is about 3 per cent.

MINE TRAMWAYS are an important feature in every mine and require to be so laid that free access is obtained to the shafts and the reduction works, &c., in the best sequence and with the least detour possible, care being taken to utilise all advantages derivable from the different levels the line may have to traverse.

Rails and the accessories necessary for laying them, will be shipped at the lowest current rates on receipt of the particulars of the line required; but it may not be convenient, or even possible, to obtain special estimates for lines required to develop new properties and the following information will give engineers in charge of such works facilities, for making approximate estimates of the cost per mile of portable or permanent railways and of crossings, switches, turntables, and rolling stock.

The prices are based on the present cost of materials and labour and include steel rails, steel sleepers, spaced at from 2 ft. 9 in. to 3 ft. centres, clips, fish plates and bolts all complete ready for laying.

The curved lines, as usually sent out, are made to the lengths and the radius required and are rivetted to the steel sleepers ready for connection with the rails. The trucks are of the types referred to later on.

PRICES OF MINE TRAMS OR PORTABLE RAILWAY.

Weight of rails .. .. .. lbs. per yard or Kilog. per metre	12 6	14 7	16 8	20 10
Price per mile, for 18 in. (45 centimetres) gauge ..	£290	£340	£380	£480
Do. do. 20 in. (50 do.) do. ..	£295	£345	£385	£485
Do. do. 24 in. (60 do.) do. ..	£310	£355	£390	£510
Price of line .. .. per yard	3/6	4/-	4/6	6/-
Do. .. .. per metre	3/11	4/5	5/-	6/6
Price of curved line .. .. .. per yard	4/3	4/9	5/3	6/10
Do. do. .. .. .. per metre	4/8	5/3	5/9	7/6

SWITCHES AND CROSSINGS for lines as above, are rivetted to the cross sleepers in the same manner as the curved roads. The length of each section is 15 ft. and the maximum curve is 30 ft. radius. The switches have a cross bar and are easily moved by the foot.

PRICES OF STEEL SWITCHES AND CROSSINGS.

Weight of rails .. .. lbs. per yard	12	14	16	20
Price of three-way crossings for 18 in. gauge	£6 15 0	£7 10 0	£7 15 0	£8 5 0
Do. do. do. 20 do.	£7 0 0	£7 15 0	£8 0 0	£8 15 0
Do. do. do. 24 do.	£7 7 6	£8 10 0	£8 15 0	£9 10 0
Do. two-way do. 18 do.	£3 8 6	£3 14 0	£3 17 6	£4 2 6
Do. do. do. 20 do.	£3 11 0	£3 16 0	£4 2 6	£4 7 6
Do. do. do. 24 do.	£3 16 0	£4 2 0	£4 10 0	£4 15 0
Do. right & left do. 18 do.	£4 5 0	£4 12 6	£5 0 0	£5 10 0
Do. do. do 20 do.	£4 10 0	£4 17 6	£5 5 0	£6 0 0
Do. do. do. 24 do.	£4 15 0	£5 5 0	£5 12 6	£6 2 6
Do. four-way do. 18 do.	£3 10 0	£3 15 0	£4 0 0	£4 5 0
Do. do. do. 20 do.	£3 12 6	£3 17 6	£4 2 6	£4 7 6
Do. do. do. 24 do.	£3 17 6	£4 2 6	£4 5 0	£4 10 0

If the crossings are made with fixed cast iron switches, deduct 15/- each.

PORTABLE TURNTABLES with any section of rail referred to in the foregoing tables are made with wrought iron or cast iron chequered revolving table; they are properly balanced and supported on a central pivot and provided with stop catches, packing pieces, &c.

PRICES OF PORTABLE TURNTABLES.

Diameter of table	2 ft. 10 in.	3 ft.	3 ft. 6 in.	3 ft. 9 in.	4 ft.
Price with wrought iron plate..	£4 10 0	£6 0 0	£6 10 0	£7 0 0	£8 0 0
Do. cast iron plate ..	..	£5 0 0	£5 10 0	£6 10 0	£7 0 0

The cost of packing this kind of plant for shipment and delivery f.o.b. is usually very small, but if anything special is required it will be charged on the lowest scale.

INCLINE GEARS.—The engravings Fig. 6043 to Fig. 6044 illustrate systems, the details of which are carried out to suit an endless variety of circumstances. To these might be added, if space permitted, steam hoists with single and double drums (referred to in Section II.) water balance and other types but, as these gears are invariably constructed to suit local conditions, the question of design, cost, &c., can only be dealt with on information relating to those conditions.

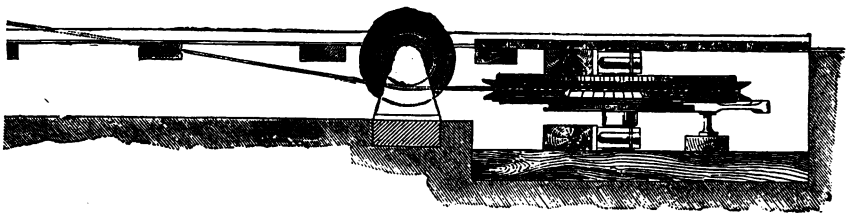


Fig. 6043.

SELF-ACTING INCLINE GEARS.—Fig. 6043 represents an arrangement (frequently modified), in which the weight of the descending loaded trucks hauls up the empty trucks. A strong V pulley is frequently used in lieu of the clip pulley shown in the engraving.

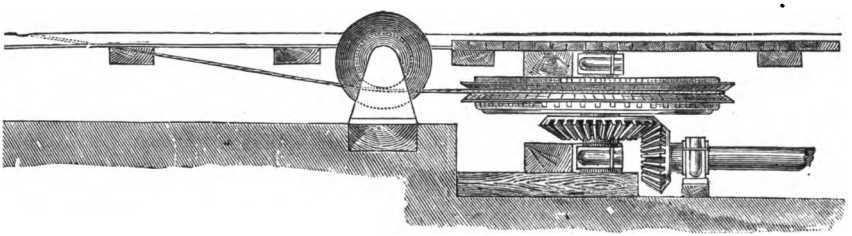


Fig. 6044.

POWER HAULING INCLINE GEARS.—The conditions last referred to are reversed in the arrangement indicated in Fig. 6044, the full load being hauled and the empty trucks lowered. In other respects the foregoing remarks apply to this system and to them may be added, that the pulley is as often fixed on a stage above the trucks, as it is in the position shown.

CHAIN OR ROPE DRUM INCLINE GEARS, driven by belt or rope from an existing shaft are as largely used for hauling minerals, metals, coal, clay, &c., and the cost of the rope or chain drum, brake or clutch gear, one cubic yard end or side tipping truck, 100 feet of narrow gauge steel railway, with spikes. &c., carrying roller and 150 feet of steel wire rope or chain, is about £60. If with steam winch. in lieu of belt driven drum, the cost is about £100.

MAN ENGINES.—Although one or other form of winding gear has, to a large extent superseded the "Man Engine," it is still employed in metalliferous mines and the subjoined information may be of service to Mine Owners or Managers who have not had occasion to design these appliances.

The timberwork, almost invariably made at the mine, consists merely of the vertical beams with platforms (sollars) at intervals, corresponding with those fixed on the side of the shaft opposite to the moving spears; the slow speed at which these move admit of the men stepping from one platform to the other for going down or coming to the surface.

The ironwork comprises the quadrant piece or "bob lever" similar (but with some modifications) to that illustrated in Fig. 6034. with gudgeons and bearings, connection to arm, &c. and may be constructed mainly of timber, or entirely of iron as mentioned at p. 40.

If the quadrant piece is made of timber the cost of the requisite ironwork is about £50.

If of iron, the cost of all metallic appliances is £100.

Drawings will be furnished for the installation of either system, on receipt of information as to dimensions of the shaft, the number of men to be passed in a given time and, if necessary, the speed in revolutions of the shaft which will work the quadrant.

INCLINE ROPES.—The wide variation in the quality and current market price of the materials used in their manufacture renders it impossible to arrange reliable prices in advance.

The approximate cost of the highest quality rope will, however, be found at p. 52.

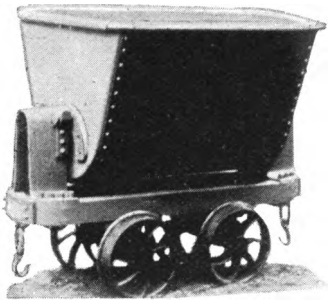


Fig. 6046.

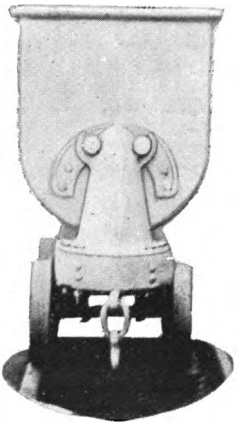


Fig. 6047.

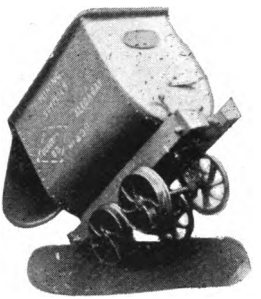


Fig. 6048.

STEEL MINE TRUCKS of the construction shown in Figs. 6046 to 6048, to tip to either side or to either end, are supplied in large quantities to the Gold Fields and Diamond Mines of South Africa, and for many purposes elsewhere.

The structural details have been perfected in accordance with suggestions made from time to time, by experienced mine managers and, as now made, are not liable to the distortion and "crumpling" so often seen with ordinary trucks which—for cheapness—are made too light to stand even ordinary wear and tear.

The truck body (which is most subject to wear) is formed of a single steel plate with ends flanged and rivetted in and is secured at the top, to an iron bar which forms a frame of ample strength; a buffer bar is rivetted to the part of the truck body which strikes the undercarriage when tipping, and it is carefully balanced on steel trunnions carried on steel pedestals as shown.

The undercarriage is of rolled steel of ⌊⌋ section and is provided with steel wheels and axles, pedestals, draw gear, &c.

These trucks can be mounted on springs if desired, at a slight extra cost and, for economy in freight and convenience in re-erection, the separate parts are, as far as possible, packed inside the truck body.

PRICES OF STEEL MINE TRUCKS, Figs. 6046 and 6047.

Capacity of truck .. .. cubic feet	10	15	20
Price, to tip either side, gauge 16-24 in.	£7 15 0	£8 10 0	£9 10 0
Do. do. end, do.	£8 2 6	£8 15 0	£10 0 0
Approximate shipping measurement, for 5 trucks nested	1 ton	1½ tons	1½ tons

PRICES OF STEEL MINE TRUCKS, Fig. 6048, (to open at ends.)

Capacity of truck .. .. .. cubic feet	10	16	20
Price, 16-20 in. gauge	£6 15 0	£8 5 0	£9 5 0
Price, 24-36 in. do.	£7 5 0	£9 0 0	£10 10 0
Approximate shipping measurement, for 5 trucks nested	¾ ton	1 ton	1½ tons

Packing for shipment only costs 3 per cent.

MINE TRUCK TUMBLERS are frequently made to designs supplied by the manager of the mine or works where they are to be used, but a simple form of tumbler adopted by the Writer, seems well suited for most purposes.

This consists of a platform built of steel channel bars to which the rails are rivetted to suit the gauge required; this is suspended from a pair of steel side frames provided with steel gudgeons (one at each side) and bearings for attaching to a timber frame or masonry at the tip. A cross bar stops the truck and holds it in position whilst being tipped, the balance being adjusted for the platform to swing as soon as the truck reaches the cross bar and to return, almost automatically, when the load has been discharged.

The prices of these tumblers vary in proportion with the capacity of the truck, the gauge, &c., but usually cost from £8 to £12 each.

MILL HOUSES should (unless built in masonry) be constructed as far as possible of iron, rather than timber which presents greater risks on account of fire. In all cases galvanised iron roofing may be used with advantage and a support should be provided on the wall or columns carrying the roof for the rails on which an overhead travelling crane may work; for details of the various types of overhead travellers and their application, reference should be made to the data relating to hoisting machinery in Section II. of this work.

Special estimates will be prepared for the supply of mill houses complete as above described, on receipt of the necessary information, but it may be mentioned that a suitable galvanised iron roof with columns, etc, for a large mill house is worth 2/- per square foot of area; the average weight is about 1 cwt. for each 10 square feet of area covered.

MERCURY WELLS and riffles are generally made of well seasoned hard wood and form part of the timber work for the amalgamating tables. Sometimes they are made of sheet copper amalgamated on the inside. Another form which has been used with great advantage is the enamelled iron well invented by the Writer and made by his firm.

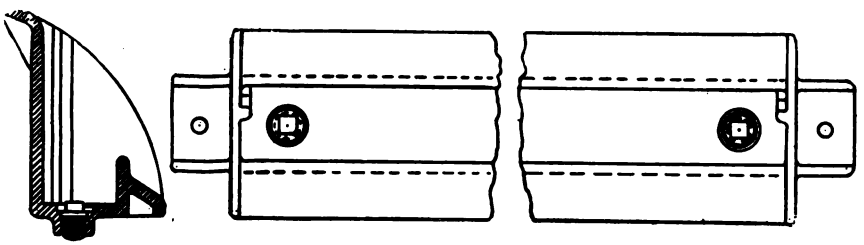


Fig. 6049.

ENAMELLED IRON MERCURY WELLS, Fig. 6049.—This invention is referred to by Mr. Henry Louis in his admirable "Handbook of Gold Milling," as follows:—"One of the best forms of mercury well is shown in the annexed figure. It is made by Messrs. Appleby Bros. of London. The material is cast iron and it is enamelled on the inside. The baffle board slides in grooves and can be fixed by wedges at any desired point. A screw plug is provided in the bottom, by means of which the mercury and amalgam can be drawn off when it is desired to clean out the wells."

The price of the riffles as above described is £5 for each 5 head of stamps and their convenience, cleanliness, and the fact that the amalgam can, if desired, be kept under lock and key are strong recommendations to reduction officers.

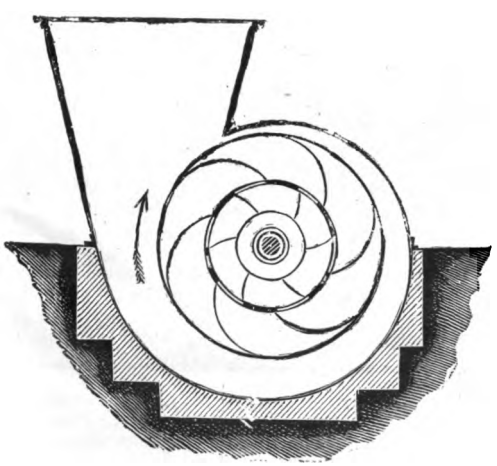


Fig. 6050.

THE CAPEL MINE VENTILATOR, specially designed for moving large volumes of air in Mines and maintaining (if desired) a high water gauge, is shown in section by Fig. 6050.

The air enters the fan at each side and is received in the cylindrical chamber containing six blades projecting inwards, and curved with the convex side in the direction of rotation. The vacuum created by the revolving wings causes the air to be discharged through the porthole between each pair of wings, as indicated in the engraving, and to emerge from them at a velocity of about 1720 feet per minute when the fan is making 200 revolutions per minute. The air, therefore, is discharged against the concave side of the outer wings; the result of this is that a large portion of its "vis viva"

is taken up by the outer revolving wings, and the velocity of the air is greatly reduced by reason of its entrance into the very much larger chamber between the cylinder and the outer wing. The air is discharged from the tips of the outer wings, into the gradually increasing spiral fan race and is delivered through the conical outlet into the atmosphere, at a still further reduced velocity. The fans are made encased or open, and with single or with double inlet, and, under the conditions referred to in the following tables, they maintain a water gauge pressure of 2.5.

It will be understood that the higher the speed the greater will be the volume of air and the W.G. ; or greater volume with lower W.G. at the same speed and so on.

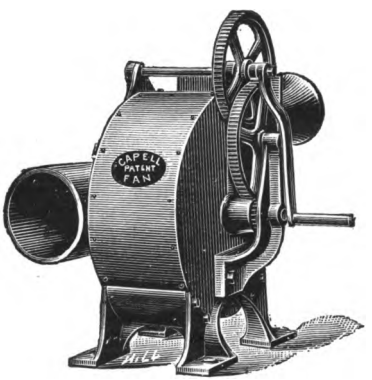
PRICES OF ENCASED FANS, Fig. 6050, WITH DOUBLE INLET.

Diameter of fan	8 ft.	10 ft.	12 ft.	12ft. 6in.	15 ft.
Width ,, ...	7 ft.	8 ft 6 in.	10 ft.	11ft. 6in.	11ft. 6in.
Revolutions per minute	300	240	210	210	180
Delivery, cub. feet per minute	100,000	150,000	200,000	250,000	300,000
H.P. in air	40	60	80	100	120
Price of fan	£400	£578	£900	£945	£1105
Power required .. .. ..I.H.P.	60	90	120	150	180

PRICES OF ENCASED FANS, Fig. 6050, WITH SINGLE INLET.

Diameter of fan	8 ft.	10 ft.	12 ft.	12ft. 6in.	15 ft.
Width ,, ...	4 ft.	4 ft. 6 in.	5 ft. 4 in.	5 ft. 8 in.	6 ft. 6 in.
Revolutions per minute	300	240	210	210	180
Delivery, cub. feet per minute	50,000	75,000	100 000	125,000	150,000
H.P. in air	20	30	40	50	60
Price of fan	£205	£362	£475	£499	£605
Power required .. .. ..I.H.P.	30	45	60	75	90

The cost of packing for shipment and delivery f.o.b. is per 6 cent.



Fig, 6051.

HAND-POWER MINE FAN.—The engraving, Fig. 6051, illustrates a type which possesses many advantages for the numerous purposes for which it has been designed, and is largely used in this country, on the Continent of Europe, and elsewhere.

The construction of the fan is similar to that shown in Fig. 6050 in the arrangement throughout ; as indicated in the engraving, it is exceptionally compact and combines maximum useful effect and durability with a minimum total weight. Another object sought has been to dispense entirely with the use of belts because, excellent as belt driving is under many conditions, it is the reverse of desirable in a wet and dirty mine, or in one where the sectional area of headings, drives, etc., is so limited as it is in many mines where thin seams prevail, leads have to be followed, etc.

As will be seen from the engraving, the fan is driven by spur gear throughout and the total weight is well within that which can be carried by two men, even in confined workings. These fans are found to work efficiently when forcing air through pipes up to 350 yards long.

PRICES OF MINE FANS, FIG. 6051.

Diameter of fan	ins.	10	14	20
Delivery, cub. ft. per minute		420	700	1400
Price of fan	each	£12 10 0	£15 15 0	£23 10

MINING STORES.—These are referred to under their respective headings, in this and the other sections of this series, but the subjoined additional approximate prices may be useful when estimates, indents, &c., are being prepared.

MINING STORES AND SUNDRIES.

Enamelled iron mercury buckets, 10 in. diameter, each 8/6. 12 in diameter, each 12/6.
Amalgam safes, each £6.
Prospecting pans, each 2/6.
Ditto, with copper bottom, each 8/6.
Stamp screens, woven wire, per square ft. 1/-.
Charcoal iron screens, perforated, per square ft. 2/10.
Ditto, slotted, per square ft. 2/6.
Special scarlet blanketing, for blanket strakes 64 in. wide, per yd. 4/-.
Special stout cloth or "duck" for ditto 22 in. wide, per yd. 3/9.
Safety fuse, per ft. 3d., 3½d., 4d, 5d, 6d, 7d., 9d. and 1/-.
Dynamite shipped at lowest current rates.
Mining lamps from 3/6 each.
Engine oil, per gallon 2/9.
Fine olive oil, per gallon 4/3.
Miners' picks, each 1/, 1/3 and 1/6.
Pickaxes, each 9d., 1/-, 1/3 and 1/6.
Best ash handles for the above, per doz. 20/-.
Best octagon drill steel, per cwt. 38/- to 48/-.
Miners' hammers, best crucible steel, per lb. 1/-.
Spalling hammers, per lb. 6d.
Miners' shovels, per doz. 40/- to 50/-.
Wheelbarrows, all steel, 32/6.
For prices of belting and hose see Sections IV. and V of this work.
For prices of portable forges, fans for ventilating and other purposes, see Section IV. of this work.
Hand power double geared ventilators for mines, £12 10 0 and £15 10 0 each.
Quicksilver or mercury is sold in flasks containing about 75 lbs. each, and the average market price is about £8 per flask, but this varies so greatly that, where large quantities are required a special estimate should be obtained, or instruction given to ship at lowest current rate.
Appleby's special steel shoes and dies, see remarks hereon pages 15 and 16.

ANEMOMETERS.—These useful instruments automatically register the velocity of the current of air passing through Mine passages, Sewers, Ventilators in buildings, etc., and clearly indicate such variations as may be due to defective arrangements, obstructions, or inattention at the ventilating fan, or furnace.

The working parts are carefully balanced and finished, and a "stop" is provided to arrest the action of the indicator when the period for observation has been reached.

The watch size (2 in. diameter) is enclosed in a case which, when opened, forms a base for the instrument. It registers up to 1000 feet and costs £4 4s. 0d.

Those for higher readings up to 10 million feet are carried in a small mahogany case about four inches square and cost from £3 to £4 each.

CALORIMETER.—It seems singular that the simple and efficient apparatus known as "Thompson Calorimeter" is not more commonly used by Coalowners and Consumers, for the purpose of ascertaining the evaporative value of the fuel they sell or use.

The tests can be made by anyone with average intelligence, and the cost of the complete apparatus, fitted in a case. is £6 10s.

SURVEYING INSTRUMENTS.—Without going into details of instruments to equip the Surveyor's office, it may be well to give the following prices at which serviceable instruments for mining surveys can be supplied.

Transit Theodolites, divided on silver, with tangent adjustments and all usual fittings and accessories, tripod stand, mahogany case, &c., 5 in, price £25 10; 6 in., price £28 10.

Ordinary Theodolites.—4 in., price £20; 5 in., price £22 10; 6 in., price £26.

Dumpy Level in case with tripod stand, price £5 5 0

Levelling Staffs.—6 ft. long, folding to 28 in., price £2 5 0; 8 ft. long, folding to 36 in., £2 10 0.

Miner's Compass, price £7 10 0

Steel Chains, 50 ft. long, about £1 10 0

Circumferenters, ... 5 in., price £15 0 0; 6 in, £16 10 0

COLLIERIES AND COLLIERY PLANT.—Although, as mentioned on page 1 of this Section, the limits at our disposal are quite inadequate to deal with a subject so wide as this is; the following notes on the present costs in this country (for which the writer is largely indebted to the Handbook for Colliery Officials) together with other matters referred to in this work, may perhaps be of some service in determining whether, and to what extent, outlay shall be incurred in the search for coal or minerals, or in plant for extraction.

The headings direct attention to the several details which, it is probable, will need to be considered; this method is adopted as being concise and convenient for reference.

BORING FOR COAL, MINERALS, &c.—The two methods of boring for coal and minerals are by means of the ordinary tools illustrated and described at page 36-37, or the diamond drill—for the design and introduction of which the writer is largely responsible—referred to at pages 27 to 31.

Ordinary boring—The standard prices in this country are as follows:—

£0 1 3 per foot for the first 30 feet
£0 2 6 per foot for the next 30 feet
£0 3 9 per foot for the following 30 feet

and increasing in the same proportion for greater depths.

But there are so many contingencies in work of this kind, which cannot be foreseen, that the total cost of the bore at these standard rates is frequently exceeded.

As an instance of this, a bore hole made to a depth of 693 feet, through millstone grit and mountain limestone cost £725

Boring with diamond drill.—The standard prices in this country are as follows:—

£0 6 0 per foot for the first 100 feet
£0 12 0 per foot for the next 100 feet
£0 18 0 per foot for the following 100 feet

and increasing in the same proportions for greater depths.

A diamond prospecting machine of the type Fig. 6021, page 27, put down a bore hole to a depth of 822 feet, in the same locality as that last referred to, at a cost of about £987 0 0

Another bore was made to a depth of 258 feet and cost about £111 0 0

But the foregoing remarks with reference to unforeseen contingencies and the extra cost they entail, frequently apply equally to this system.

Amongst the advantages of the diamond drill may be mentioned:—1, that it provides a record of the whole of the strata, through which the drill passes; 2, that the time occupied in the work can be estimated with considerable accuracy; and 3, that losing a hole by jamming of tools, &c. is, practically impossible.

Percussion drilling (the American system) so much used in the United States and referred to on pages 31 and 32, gives excellent results in boring for petroleum, brine, &c., but cannot be recommended for prospecting for coal or minerals.

Bore holes, 8 inches in diameter, have been put down to a depth of about 950 feet, in about three weeks, including lining.

The total cost of the bore, lined with steel pipes, and provided with engine, pump, engine house, &c. for each bore, was about £1950 0 0

SHAFT SINKING.—The approximate cost of sinking a 14 ft. shaft to a depth of 600 feet, exclusive of engines, winding gear, &c., is £1,400, or an average about £2 7 0 per foot.

Providing that there is not much water, the total cost is about £8 10 0 per foot of depth; this includes walling beds, cast iron ring cribs for walling and fixing, walling with fireclay lumps, main brattice (about 8/6 per foot run,) wood guides (about 7/- per foot run,) wire rope guides, tubbing, engines, boilers, pit-head gear, &c. But if much water is present, this above-named approximate cost will probably be very largely exceeded

The Kind-Chandron system.—The cost of shaft sinking by this system has varied between the very wide limits of £12 10 0 to £56 0 0 per foot of depth for sinking and without equipment.

PUMPING ENGINES.—These are referred to elsewhere in this Section and in Section 3, but the following data with reference to works executed may be useful.

Horizontal Cornish pumping engine, 44 by 12 inches, and 48 inch stroke, forcing 500 gallons per minute to a height of 600 feet and working with steam at a pressure of 30 pounds per square inch costs.. .. .. £750 0 0

Duplex Cornish pumping engine, with two cylinders 32 inches diameter, 48 inches stroke, and two ram pumps costs about £800 0 0

Compound Cornish pumping engine for the above named duty but working with steam at 80 lbs pressure, has steam cylinders 21 and 36 inches diameter with 24 inches stroke, and ram pump 12 inches diameter, and costs £650 0 0

Duplex Cornish pumping engine with two steam cylinders 15 inches and two 26 inches diameter, 24 inches stroke, and two rams 9 inches diameter, costs £790 0 0

These costs might be multiplied almost indefinitely, but the approximate cost of many types of pumping engines may be obtained by reference to Section 3, or by special quotation for machinery to fulfil conditions which may not be mentioned in this or the other Sections.

Hydraulic mine pumps, see Fig. 6032, page 41.

Electric mine pumps, see Fig. 6033, page 42.

Cost of pumping.—This is affected by the cost of fuel and other items, and, necessarily varies rather widely. The approximate cost of pumping to a height of 600 feet will, however, probably average about one-fourth of a penny per ton of water raised; but with high class pumping machinery, the total cost, including small coal at 3/- per ton, all stores, &c., interest and depreciation, has been ascertained to be 0.14 penny per ton of water raised.

WINDING ENGINES.—Some types of these will be found in Section 2, but colliery engines are, almost without exception, specially designed in accordance with the manager's views. The cost of the under-named engines, each with steam brake, is given as representing useful proportions.

HORIZONTAL WINDING ENGINES.

Diameter of cylinder	24 in.	28 in.	36 in.
Length or stroke	48 in.	60 in.	72 in.
Diameter of drum	10 ft.	14 ft.	14 ft.
Price of engine	£1100	£1350	£1925

The cost of packing for shipment and delivery f.o.b. is not included in any of the foregoing prices, but it does not usually exceed about 5 per cent.

The cost of winding if based on the quantity of coal raised, as is customary, must evidently vary very much at different collieries, but if the mine is 600 feet deep and winds 1,000 tons per day, the cost, including small coal at 3/- per ton, wages, stores, ropes, and maintenance of engine, boilers and cages, will probably be about three farthings (¾d.) per ton.

PIT-HEAD GEARS OR HEAPSTEADS, also known as "pulley frames" are referred to at page 45, but the following costs of colliery heapsteads may be useful.

Timber frame heapstead 40 feet high, constructed in pitch pine, complete with rope pulleys 8 feet diameter, with mild steel spindles, pedestals, gun metal bearings, &c., and proportioned for one full cage weighing 1½ tons, costs £85 0 0

Timber frame heapstead as above but 57 feet high, and with rope pulleys 10 feet diameter, and proportioned for one full cage weighing 5¼ tons, cost £295 0 0

Wrought iron heapstead 76 feet high, with rope pulleys 12 feet diameter, cost £1,110.

Wire rope pulleys for heapsteads made of a strong mixture of cast iron, and fitted with spindles, pedestals with gun metal bearings, &c., are made of the following dimensions and at the prices named. Pulleys with wrought iron arms are also made at some advance on these prices.

Diameter of pulley .. .. .. ft.	6	8	10	12	14	16
,, spindle .. .. .. in.	3	3	3½	4	5	5
Length of ,, ... in	6	6	6	6	7½	7½
Working load .. .. .. tons	6	6	6	6	10	10
Price of pulley with accessories	£10	£15	£21	£27	£36	£45
Approximate weight .. .. .. cwts.	11	14	20	25	33	40

VENTILATING FANS.—The proportions of the fan must be such that the velocity and volume of the current delivered, shall be sufficient to completely clear the workings of noxious gases as quickly as they are formed.

A Guibal fan, 30 feet diameter and 10 feet wide, working at 36 revolutions per minute, circulates 45,000 cubic feet of air per minute with 1 inch water gauge.

The approximate prices of the sizes commonly used are as follows:—

Diameter of fan .. .. ft.	25	30	36
Price complete with engine	£500	£750	£1135

A Waddle fan, 40 feet diameter, working at 58 revolutions per minute, circulates 126,000 cubic feet of air per minute, with 3 inch water gauge, and costs with engine, about £1,000 0 0

Root's blowers of the type illustrated by Fig. 3155, (Section 4) are also largely used for mine ventilation.

For hand power fans refer to pages 56 and 57.

BAND SCREENS.—A pair of 80 feet belts 4½ feet wide, with small belt, two jigging screens, engine for driving, &c., costs about £800 0 0

COAL WASHING MACHINERY —The advantages derived from efficient washing are beyond question, especially for coke making, and the following data relates to two of the systems in general use.

The Lührig system —The washing machinery requisite to deal with 750 tons of slack per day costs about £6,600 0 0

The plant complete, including engine power, water supply, buildings and erection ready for work, costs about £10,000 0 0

The Robinson system.—A plant to deal with 100 tons per day, including engine, elevators, tanks, pipes, &c., ready for erection, costs about £550 0 0

The consumption of fuel for steam power is about 10 cwt. per day, and one attendant is required.

COKE OVENS.—The arrangements for the Coppè, Simon, and other (frequently called) "patent ovens" vary so widely, that it is always desirable to obtain special designs and estimates for them.

Beehive coke ovens of the ordinary dimensions, if the average cost of fire bricks is 46/- and common bricks 24/- per thousand, cost each, about £36 0 0

A range of twelve ovens 11½ feet diameter and 8 feet 6 inches high with chimney, railway, &c., costs about £650 0 0

TRUCK WEIGHING MACHINE to carry 30 tons and weigh up to 20 tons, without relieving gear, costs £112 0 0

PIT BANK WEIGHING MACHINE with self indicating gear:—

Diameter of turn table	3½ ft.	4 ft.
Price of machine	£48	£55

CARTS for one horse cost from £12 to £14 each.

CART WEIGHING MACHINE, entirely self contained and to weigh up to 4 tons, costs about £33 0 0

MINE TRAMS or "rolleyways," with steel rails weighing about 25 lbs. per yard, fish plates and bolts, spikes, timber sleepers and laying, may be estimated to cost per yard about 3/-

Points and crossings with steel rails, switch rods, levers, boxes, &c., complete, cost, per set, about £13 0 0

MINE CAGES.—The dimensions and cost of cages varies so widely, that accurate estimates cannot be made until drawings and specifications have been agreed. But the cost of steel mine cages for collieries may be approximately ascertained by estimating that the weight of a cage will be rather more than half the total weight of load and tubs lifted, and that the materials and labour, including shoes and tumblers, are worth about £30 per ton.

In illustration of this, a double steel cage, to carry two tubs on each deck, weighs about 2 tons, and costs £60 0 0

TIMBER MINE TUBS, with steel wheels and axles to carry about 10 cwt., and weighing, when empty, about 5½ cwt., adapted for main and tail rope haulage, cost, each, about £3 15 0

The cost of repairs and upkeep is usually about 11 per cent per annum on the cost of the tub.

STEEL MINE TUBS, for the same system of haulage, with steel wheels and axles, to carry about 10 cwt. and weighing when empty, about 6 cwt., cost each, about £4 0 0

The cost of repairs, &c. is about 12 per cent. per annum.

BRANCH RAILWAY LINE, to connect the mine with the main line. Assuming that steel rails weighing about 80 lbs. per yard are used, the cost, including rails, fastenings, sleepers and laying will be about £1320 per mile or approximately, per yard 15/-.

MAIN LINE COAL OR MINERAL TRUCKS.—The cost of these is necessarily influenced by the specification of details of construction but, at the present prices of materials, &c., if a number of one type are required, excellent and serviceable trucks, complete with all accessories for running with permanent way stock in accordance with English regulations, can be made at the undernamed prices.

Capacity of truck .. .. tons	8	10
Price each with hopper or drop bottoms	£55	£58
,, with side doors	£52	£53
,, with end doors	£54	£55

Taking to pieces for shipment, marking for re-erection, packing and delivery f.o.b., will probably cost 5 or 6 per cent.

LOCOMOTIVES FOR MINE SERVICE.—Reference is made in Section 5 to locomotives for various purposes, but the undernamed are so largely used for mine service, that it may be convenient to mention them in connection with this subject.

The engines have outside cylinders and are provided with cab, coal bunkers, water tank, &c. and they are complete with all accessories usual for this service.

Diameter of cylinder	10	12	14	14	16
Number of wheels coupled	4	4	4	6	6
Weight in running order .. .. tons	16	19½	24½	28	37
Price of engine	£620	£720	£940	£1060	£1300

The cost of packing, &c., see "Main line, &c., trucks."

LOCOMOTIVE HOUSE to house four engines, substantially constructed in masonry, height to eaves 14 ft., length 64 ft. and width 25 ft. and provided with fitters' benches and small tools for repairs, cost £360.

For a small equipment of machine tools for more extensive repairs, add £100 to £200.

A locomotive house of similar dimensions built of corrugated galvanized iron, erected and marked for re-erection costs about £250.

SECTION VI. PART B.

COLONIAL AND MANUFACTURING MACHINERY.

CONTENTS

AND CODE WORDS FOR USE IN CONJUNCTION WITH APPLEBY'S COPYRIGHT TELEGRAPHIC CODE.

	CODE NO.	CODE WORD	PAGE
Scalpers or Sifters, Corn	075737	*Falkeneule*	30
Screw and Nail Making Machinery	075738	*Falkenhof*	56—57
Screw Baling Presses	075739	*Falkenjadg*	42—43
Screw Making Machines, Wood	075380	*Falkia*	57—58
Screw Presses, Tile and Brick	075381	*Falkonet*	78
Sectional Brick Burning and Drying Kilns ..	075382	*Fallabile*	79
Seed Crushing Rolls, Anglo-American	075383	*Fallacibus*	48
Seed Heating Kettles	075384	*Fallacienx*	48—49
Separators, Rice	075385	*Fallacion*	21
Sewing Machines, Cotton and Canvas Belt ..	075386	*Fallacious*	68
Sewing Machines, Leather, &c.	075387	*Fallacium*	67—68
Shoe Making Factories, Complete Plants ..	075388	*Fallacy*	65—67
Shoe Making Machines	075389	*Falladeira*	62—68
Sifters and Scalpers, Corn	075390	*Fallamento*	30
Sifting Machines, Bakery	075391	*Fallanza*	84
Slag Disposal Plant	075392	*Fallarum*	95
Smoke Destructors	075393	*Fallatoria*	94
Soap Making Plant	075394	*Fallava*	72
Softening and Purifying Water	075395	*Fallavano*	86—87
Steam Presses, Tile and Brick	075396	*Fallbeil*	78
Steel Making Plant, Siemens Martin and Bessemer	075397	*Fallebamus*	94
Stills, Rum and Continuous	075398	*Fallebas*	13—14
Stop Valves, Hydraulic	075399	*Fallecemos*	41
Strap and Harness Making Machines	075400	*Falleisen*	67—68
Strap and Hose Pipe Punching Machines ..	075401	*Fallencia*	69
Straw and Hay Baling and Trussing Presses ..	075402	*Fallender*	43
Sugar Boiling Pans	075403	*Fallenie*	8
Sugar Centrifugal Machines	075404	*Fallenohr*	10
Sugar Clarifiers	075405	*Falleremmo*	9
Sugar Defecators	075406	*Falleremus*	9
Sugar Eliminators	075407	*Fallereste*	10—11
Sugar Evaporating Pans	075408	*Fallevole*	9
Sugar Filter Presses	075409	*Fallezcais*	9
Sugar Mills and Machinery, Complete Plants ..	075410	*Fallgatter*	1—5
Sugar Mills, Animal Power	075411	*Fallgeld*	7
Sugar Mills, Belt Driven	075412	*Fallgrube*	5—6
Sugar Mills, Intermediate Gears	075413	*Fallhaus*	5—6
Sugar Mills, Portable	075414	*Fallholz*	7
Sugar Mills, Three Roll	075415	*Fallhut*	6
Sugar Mills, Water Power	075416	*Fallido*	5
Sugar Mills with Engine	075417	*Falligione*	5
Sugar Production	..	..	1
Sugar, Vacuum Pans	075418	*Fallitore*	12
Sugar, Wetzel Pans	075419	*Fallivel*	12
Tapping Machines, Nut	075420	*Falladen*	54—56
Taps and Dies for Bolt Making	075421	*Falloir*	56
Tea Drying or Firing	075422	*Fallopian*	27—28
Tea Preparing Machinery	075423	*Fallopie*	26
Tea Rolling Machinery	075424	*Falloppa*	26—27
Thrashing Machines, Rice	075425	*Fallotomia*	18
Tile and Brick Presses	075426	*Fallowist*	77
Tile, Pipe and Brick Machines	075427	*Fallowness*	77
Tipping Trucks	075428	*Fallpfahl*	75
Tincture and Juice Presses	075429	*Fallraum*	98
Tin Pipe Making Plant	075430	*Fallriegel*	52—53
Tools for Baling	075431	*Fallsack*	39
Tools for Printers	075432	*Fallschirm*	71
Triple Effet and Evaporating Pans	075433	*Fallstrick*	11—12
Trussing Presses, Hay and Straw	075434	*Fallsucht*	43
Twine Making Machinery	075435	*Falltau*	26
Type, Printers' Tools, &c.	075436	*Fallthor*	71
Under Runner Grinding Mills	075437	*Falltrank*	33

COLONIAL AND MANUFACTURING MACHINERY.

COLONIAL & MANUFACTURING MACHINERY.

SUGAR MILLS AND SUGAR MACHINERY.—The processes of manufacture in this important branch of production are so largely influenced by circumstances, such as—the quantity and quality of sugar to be made in a given time—the local conditions in regard to facilities for transport, cost of fuel, labour, &c.—that the cost of complete mills must often be matter for special consideration and estimate. If the purchaser has not a specification prepared by the mill engineer, which embodies his views as to the appliances to be used and their arrangement, accurate data should be furnished relating to these matters and to any others which will aid in the preparation of plans and estimates.

The following specifications and approximate estimates referring to mills which have given satisfactory results, under certain conditions, are however given in the hope that they may assist planters in determining what kind and arrangement of plant they will adopt, leaving the question of modification, &c. to be settled by personal interview or by correspondence.

The foregoing remarks scarcely apply, however, to the smaller cane crushing and sugar making plants which, from constant use extending over many years, are so well known that they come within the category of agricultural machinery, and are ordered by correspondence, in full reliance that, every improvement will have been adopted which experience and practise has suggested.

In the limited space at disposal it is—unfortunately—impossible to illustrate and describe many appliances connected with sugar making, but full information on all such subjects will be furnished on application.

The approximate estimates relating to the quantity of sugar produced in a given time, are based on the assumption that about 100 lbs. of fresh cut cane will yield from 60 to 80 lbs. of juice; this is equivalent to 10 to 20 lbs. of raw sugar from 100 lbs. of juice, or rather more than 100 lbs. of sugar from 100 gallons of juice.

APPROXIMATE ESTIMATES FOR SUGAR MILLS.

A MILL CAPABLE OF MAKING 9 to 10 TONS of sugar per day of 12 hours and to consist of:—

Three multitubular boilers each of 85 nominal horse power, constructed of steel plates double rivetted in the longitudinal seams, steel ends in one piece, complete with steam chamber, large independent furnace, automatic megass carrier, steam and feed water fittings with all the seatings for mountings rivetted to boiler.

Wrought iron chimney for above with foundation plate and bolts, guy stays, &c.

One horizontal double-acting donkey engine for feeding boilers.

Cast iron hot water tank.

Two horizontal cane crushing mills each with three rolls 24 in. diameter and 48 in. long, gun metal bushes and cast steel pinions. These are mounted in massive frames and driven by strong double gear and each mill is complete with lubricators, foundation bolts, &c.

Spare parts for mills consisting of 6 steel pinions for roll gudgeons, 2 cast iron intermediate pinions and 2 cast steel crank shaft pinions.

Two liquor pumps with gun metal plunger, valves, cast iron tank, copper strainers, delivery pipe, &c.

Two non-condensing horizontal steam engines of massive proportions, heavy fly wheels, high speed governors, link reversing gear, lubricators, foundation bolts, &c.

Intermediate carrier with wrought iron sides, cast iron columns, friction clutch, complete with driving apparatus, double table and steaming apparatus.

Six clarifiers each of 600 gallons capacity, trunion pipes, copper heating tubes with all valves and cocks, wash out plug, water traps and blocks to raise the water for cleaning.

Two evaporating and cleansing pans, with trunion pipe and chests, copper heating tubes, all valves and accessories, including washing out and lifting appliances for cleaning.

One vertical triple effet consisting of three vessels, the tube chambers constructed of steel and provided with solid drawn brass tubes and large copper circulating tubes, also save-alls, condensed vapour pipes, steam receiver, valves and other necessary accessories.

Iron staging, columns, girders, handrails, wrought iron chequered floor plates for carrying the triple effets.

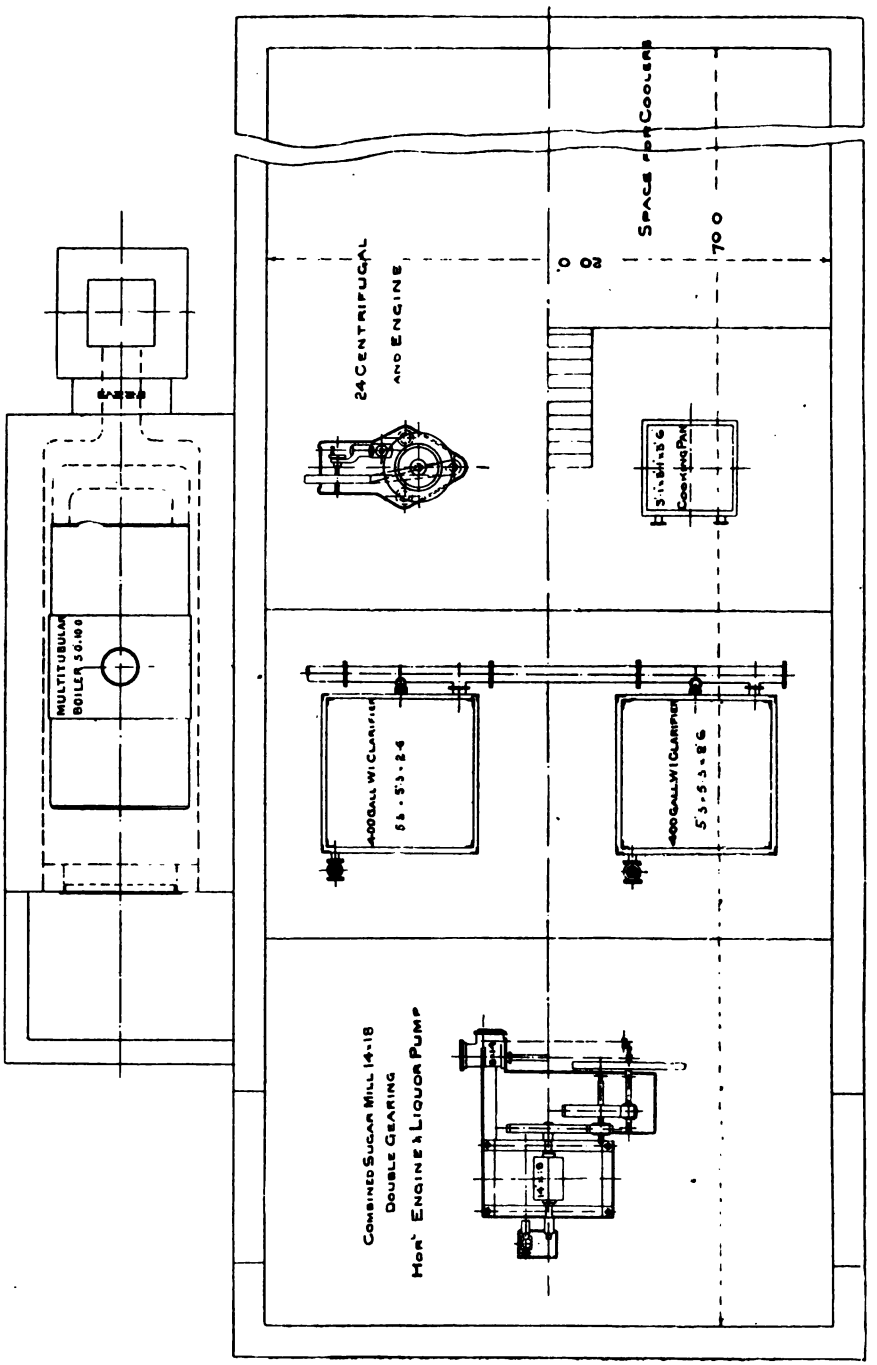


Fig. 6075.

Horizontal double acting vacuum pumping engine with two fly wheels, high speed governors, lubricators, &c.

Three self balancing centrifugal machines carried on self contained iron frames, with friction clutches, overhead mixer valves, discharge appliances, rotary gun metal pump and tank.

Horizontal steam engine complete with pipe connections, &c.

Scum clarifier with trunion pipes, copper heating tubes, all necessary valves and pipes, wash out appliances, lifting blocks, &c.

Two filter presses, each with 24 frames, lined with perforated copper plates, valves, steaming appliances, &c.

Two monjus made of steel complete with fittings.

Two molasses blow up tanks with copper perforated coils and mountings complete.

Seven wrought iron subsiders, five for syrup and two for molasses, with valve, wash out apparatus, &c.

Ten wrought iron sugar coolers grouped together and provided with valves, discharge spouts and all accessories.

Two wrought iron vacuum pan supply tanks
Two do. molasses do.
Two cast iron triple effet do.
One do. cold water do.

All pipes, valves, cocks and other accessories required to make the plant complete, the pipes for liquor being of copper and those for steam and water of iron.

The approximate (present) cost of the whole of this plant and machinery is .. £9,000.

The cost of packing for shipment will be subject to arrangement but may be estimated at 5 per cent.

A MILL CAPABLE OF CRUSHING TEN TONS OF CANE per day of 10 to 12 hours. If the mill house has to be built, the arrangement of plant indicated in Fig. 6075 will be found convenient and economical and the cost of the machinery, and of a galvanized iron mill house will be found below. If, however, existing buildings are to be utilized, the positions of the appliances can be altered to suit the buildings, the sequence of the processes being maintained as far as may be convenient.

The plant consists of a multitubular boiler of the type Fig. 1525, to be set in brickwork and the furnace arranged to use the megass for generating steam, with steam reservoir, all furnace, steam and feed water fittings, steam feed pump and steam connections between boiler and engine, &c.

Horizontal steam engine, horizontal three roll cane crushing mill with compound intermediate gear between engine and mill both of which are mounted on strong foundation plates and are complete with foundation bolts.

Brass liquor pump and tank, two wrought iron double bottom clarifiers provided with steam stop valves, gun metal discharge and wash out cocks, pipe connections, &c.

Open multitubular steam cooking pan with vertical heating tubes and fittings complete.

Patent self balancing under driven centrifugal, complete with engine. The basket is made of mild steel, safety outer case of wrought iron and the whole mounted on one strong foundation plate, and all pipes and connections required to make the plant complete and ready for erection on arrival at destination.

Spare parts will be sent comprising:—Three spare pinions for mill and one for the crank shaft to gear with the intermediate motion. Spare gauge glasses, 10 per cent. spare tubes for boiler, and 10 per cent. spare furnace bars.

The approximate price of this plant is £775.

A galvanized iron mill house will cost about £170.

If the boiler is of the independent locomotive type, Fig. 1528, which requires no brick work setting and is complete with chimney, ash pit and support for the smoke box end the extra cost is £55.

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

A MILL CAPABLE OF CRUSHING FIVE TONS OF CANE per day of 10 to 12 hours and driven by cattle power will consist of:—

A horizontal three roll cane crushing mill complete with vertical spindle and capstan head to be fitted with cattle poles.

Brass liquor pump and tank, double bottom clarifier with steam stop valve, gun metal discharge and wash out cocks, pipe connections, &c.

Multitubular cooking pan with vertical heating tubes and fittings complete.

Patent self balancing under driven centrifugal complete with engine, basket of mild steel, safety outer case of wrought iron, all mounted on one base plate.

Multitubular steam boiler of the type Fig. 1525 to be set in brickwork and complete with all furnace, steam and feed water fittings, a steam donkey feed pump, pipes and connections.

The spare parts comprise three pinions for the mill, crown wheel and pinion for cattle gear spindle, 10 per cent. spare tubes for boiler, 10 per cent. furnace bars and spare gauge glasses.

The approximate price of this mill is £525.

If with independent locomotive boiler, type Fig. 1528, which is complete with chimney, &c., and requires no brickwork setting the extra cost is £15.

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

A MILL CAPABLE OF MAKING ONE TON of sugar per day of 10 to 12 hours and consisting of:—

Vertical boiler, requiring no brickwork setting, with chimney and all furnace, steam and exhaust, and feed water fittings.

Horizontal steam engine with intermediate gearing, shafts, bearings for same with hard gun metal seatings, and strong gearing for driving the crushing mill.

Horizontal three roll cane crushing mill with adjustments, strong connecting gear, and cane shoots for feed and delivery of megass.

Five boiling pans, furnace, frame and door, fire bars and soot doors. Evaporating pan with copper coil, valves, &c., and subsiding tank.

Centrifugal machine with intermediate shaft, pulleys, driving belts, &c. Pipes and valves for the whole plant.

The approximate price for this plant is £475, and the cost of packing for shipment and delivery f.o.b. is about 5 per cent.

MILL CAPABLE OF MAKING HALF-A-TON of sugar per day of 10 to 12 hours and consisting of:—

Vertical boiler with chimney and all furnace, steam and exhaust, and feed water fittings, horizontal steam engine, horizontal three roll cane crushing mill with adjustments, strong intermediate connecting gear, and cane shoots for feed and delivery, intermediate shaft, bearings and driving gear between engine and mill.

Four boiling pans, furnace, frame and door, fire bars and flue door. Evaporating pan with copper coil, valves, &c. and subsiding tank.

Centrifugal machine with intermediate shaft, pulleys, driving belts, &c. Pipes and valves for the whole plant.

The approximate price for this plant is £375, and the cost of packing for shipment and delivery f.o.b. is about 5 per cent.

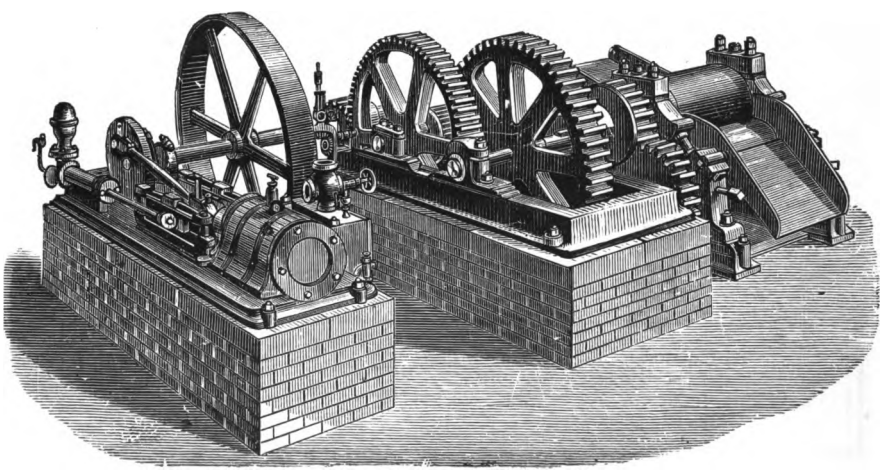


Fig. 6076.

SUGAR CANE CRUSHING MILL WITH ENGINE.—The engraving Fig 6076, represents important improvements which have been introduced, such as arranging the engine, intermediate gear and the crushing mill on separate bed plates. This increases the facilities for transport and erection, and reduces the risk of breakage.

The engine is of the horizontal type and is provided with sensitive governors, fly wheel, &c., and is mounted on a strong foundation plate of hollow section.

The intermediate compound gearing, with shafts and pedestals with hard gun metal bearings, are carried on a separate iron base plate.

The cane crushing mill has three rolls, connecting gear and adjustments which are carried in a pair of strong side frames with cane and megass shoots as indicated, see also Fig. 6077.

The cost of vertical boilers with chimney, all fittings, connecting pipes, &c., suitable for supplying steam to the engines, will be found below.

When taken to pieces, the parts are of convenient weight for transport over most roads, but if it is essential that the weights should be reduced within limits, to be stated with the order, this can be done with an increase in cost proportionate with the reduction in the limits of weight desired.

The output of sugar given in the subjoined list is what may be expected from cane, of average good quality, in a working day of 10 to 12 hours.

PRICES OF CANE CRUSHING MILLS WITH ENGINES.

Horse power required	2	4	6	8	10	12
Approximate output of sugar per day... cwts.	12	25	30	45	60	70
Price of mill complete with engine and gearing	£105	£130	£240	£340	£445	£550
Do. of steam boiler, pipes, &c.	£40	£50	£70	£90	£110	£140

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

SUGAR CANE CRUSHING MILLS DRIVEN BY WATER WHEEL OR TURBINE.—This is a convenient and economical arrangement, where a sufficient supply and fall can be obtained without too large a capital outlay. These conditions vary so widely that the cost of plant, driven by water power, cannot be estimated without accurate data in regard to the quantity of cane to be crushed in a given time—usually 10 to 12 hours—the minimum quantity of water in cubic feet or cubic metres per second or minute, and the height of fall available.

Tables will be found for ascertaining the volume and speed of the flow of water to be used for motive power, and the price of turbines and water wheels in Section 1.

In some cases rope transmission (see Mining Machinery) is used to convey power from a considerable distance to drive belt driven crushing mills, similar to those about to be referred to.

SUGAR CANE CRUSHING MILLS DRIVEN BY BELT.—For convenience in re-erection and in working the crushing mill similar to Fig. 6076, the intermediate gear and driving pulleys are carried on one bed plate for fixing to timber or masonry foundations.

These mills are complete with fast and loose pulley, belt guide, &c. and are driven by power supplied from a steam or oil engine, water wheel, turbine or other available motive power.

PRICES OF BELT DRIVEN CANE CRUSHING MILLS.

Horse power required	2	3	4	6	8
Output of sugar per day ... ... cwts.	12	15	25	30	40
Price of mill complete	£75	£85	£110	£195	£265
Do. intermediate gears	...	...	£35	£55	£70

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

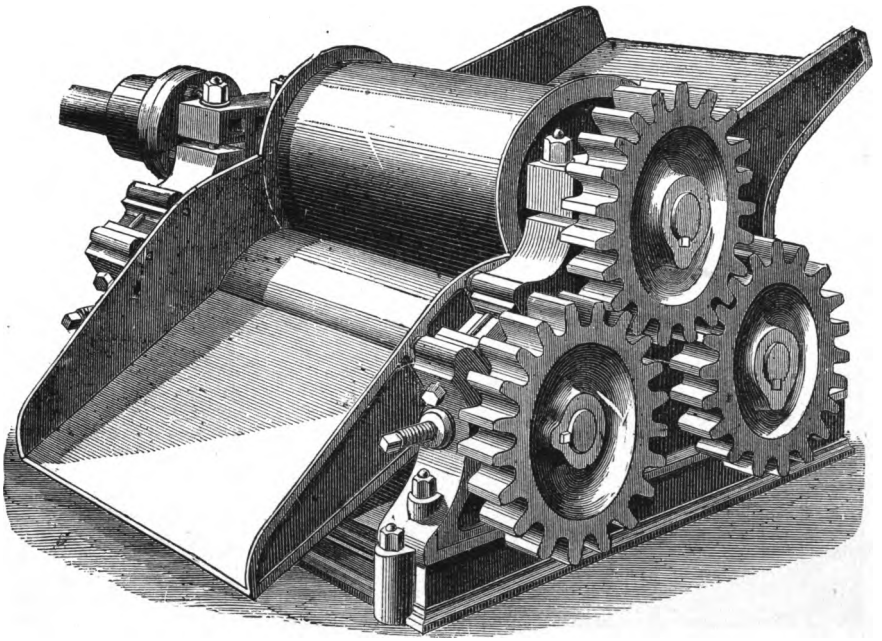


Fig. 6077.

HORIZONTAL THREE ROLL SUGAR CANE CRUSHING MILLS of the well known type illustrated by Fig. 6077 are driven by steam, water or other available motive power and fulfil the wants of small plantations or are suitable for sub-dividing the work by erecting several small mills in convenient localities on large plantations.

The mill consists of a massive cast iron base plate, to which are secured a pair of strongly ribbed side frames carrying the three crushing rolls.

The rolls are of tough close grained cast iron and are keyed on wrought iron shafts or gudgeons the ends of which are truly turned and carried in hard gun metal bearings. A strong spur wheel is secured to end of each shaft by a sunk steel key as shown, to insure the rolls being driven at equal speeds and appliances are provided for adjusting the spaces between the rolls, also for removing the bottom rolls without disturbing the top roll.

The mill is complete with a feed table and a megass shoot but not with carriers as these can usually be provided at the plantation from drawings which (if desired) will be supplied. The shaft for the top roll is prepared to receive a coupling to connect the mill, through the intermediate gear, with the motor.

The approximate output is that obtainable from cane of average quality in 10 to 12 hours work.

PRICES OF CANE CRUSHING MILLS, Fig. 6077.

Horse power required	4	6	8	10	12
Output of sugar per day ... ... cwts.	20	30	40	60	70
Price of mill	£80	£145	£190	£250	£310
Do intermediate gear	£35	£55	£70	£85	£98
Approximate weight ... ... tons	2¾	4½	6¼	7½	9¼

The cost of packing for shipment and delivery f.o.b. varies from 3 to 5 per cent.

THE CANE CRUSHING MILL DRIVEN BY ANIMAL POWER, illustrated by Fig. 6078 was originally designed to suit small holdings where, in some cases, the supply of cane was insufficient to justify the outlay for a steam driven mill, or where there was difficulty in obtaining workmen possessing any experience in working by steam power.

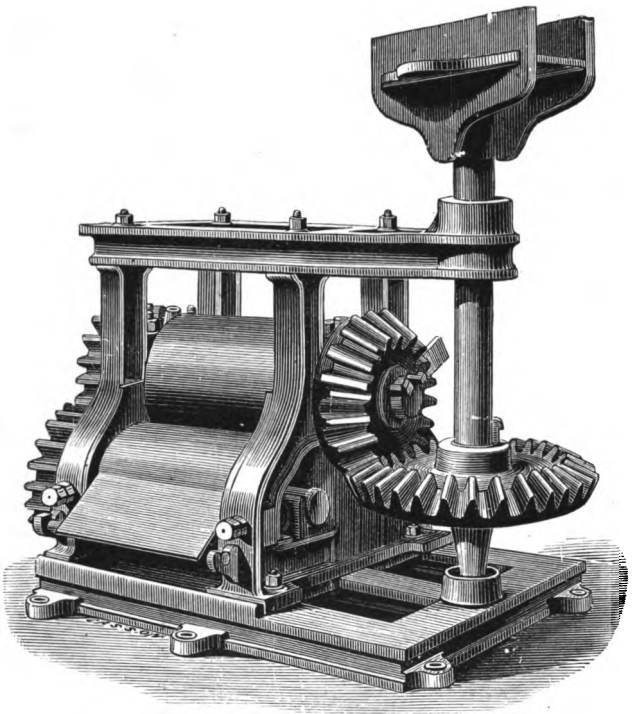


Fig. 6078.

These mills have, however, done good service in crushing cane grown on outlaying portions of large fields, where distance or difficulties in transport so enhanced the cost of bringing it to a mill that the cane must remain uncut.

The mill is of the usual three roll type and is fixed on a strong bed plate which is extended to carry the toe step of the spindle to which the capstan head for the cattle poles, is secured; the upper portion of this spindle is supported in the entablature, which is extended for that purpose. and the mill is ready for work when re-erected at destination.

It is assumed that cattle of average strength and weight will be employed; the approximate output is that obtained from cane of good average quality during 10 to 12 hours work.

PRICES OF CANE CRUSHING MILLS, Fig. 6078.

Number of cattle	1	2	3	4	5
Output per day ... ... cwts.	6	10	15	20	25
Price of mill	£35	£55	£65	£80	£95

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

PORTABLE CANE CRUSHING MILLS are constructed to combine lightness with strength and to be carried across country and worked by a bullock or mule.

The rollers are of hard cast iron and are secured to steel spindles. The pinions are flanged and both rolls are adjustable. The framing is bolted to a timber to give the requisite stability when working and it carries a juice tray with outlet nozzle in the base; the machine is complete with socket which fits on a square on one of the roll spindles and takes two poles.

PRICES OF CANE CRUSHING MILLS.

Dimensions of rolls ... ... inches	7 by 7	8 by 8	9 by 9	10 by 10
Cane crushed per hour ... ... cwts.	2½	3	4	5½
Juice expressed do. ... ...gallons	15	20	25	35
Price of mill...	£11	£13	£16	£19

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

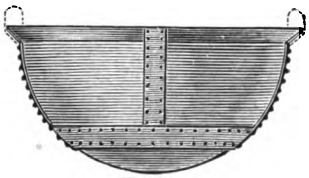


Fig. 6079.

Fig. 6080.

SUGAR BOILING PANS are made in wrought iron as Fig. 6079 and in cast iron as Fig. 6080. In both cases the bodies of the pans are of ample thickness and either type can be provided with handles, as indicated by the dotted lines in Fig. 6079.

PRICES OF WROUGHT IRON BOILING PANS, Fig. 6079.

Diameter of pans ... in.	32	41	44	48	56	65
Contents ... ...gallons	30	65	85	104	165	200
Price of pan	£4 10	£5 10	£8 10	£9 10	£12 10	£15 10

PRICES OF CAST IRON BOILING PANS, Fig. 6080.

Diameter of pans ... in.	42	45	48	52	57	66
Contents ... ...gallons	70	90	104	130	150	225
Price of pan	£3 5	£3 15	£4 5	£5 15	£6 5	£7 15

The cost of packing for shipment (if any) will vary in proportion with the manner in which the pans will "nest" with each other.

CANE JUICE HEATER complete with steam pipe and fittings, lower chamber with juice inlet and drain cock, air cock, thermometer, &c. The tubes are 2 in. diameter.

PRICES OF CANE JUICE HEATERS.

Diameter of heater ... ... in	27	30	36	42	48
Number of tubes	70	80	100	125	160
Length of tubes ... ... in.	48	54	54	60	72
Price of heater	£90	£100	£125	£150	£200

The cost of packing for shipment and delivery f.o b. is 5 per cent.

MONTE-JUS constructed of cast or wrought iron and mounted on feet to bring drain cock above floor level, and arranged for fixing vertically or horizontally as desired.

The apparatus is complete with man-hole, door and screw, steam valve, air cock, charging and discharging and drain cocks.

PRICES OF MONTE-JUS.

Capacity ... ...gallons	150	200	300	400	500
Length ... . in.	54	60	66	72	84
Diameter ... ... in.	33	36	42	46	48
Price as specified	£35	£45	£60	£75	£85
Approximate weight ... ... tons	1	1¼	1¾	2	2½

The cost of packing for shipment and delivery f o.b is 5 per cent.

CLARIFIERS in cast iron fitted with copper pipe heating coil, steam inlet valve, run off cock and plug valve for cleansing the apparatus. The depth of the vessels is, in all cases, 2 ft.

PRICES OF CLARIFIERS.

Capacity .. ..gallons	300	400	500	600	700
Heating surface of coil .. square feet	30	40	50	60	70
Length	7ft.	7ft.	8ft. 6in.	8ft 6in.	9ft. 6in.
Width	4ft.	5ft.	5ft.	6ft 2in.	6ft 2in.
Price of clarifier	£50	£60	£70	£80	£90

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

FILTER PRESSES for filtering clarified juice and skimmings, are constructed in various ways; that adopted in the press under consideration is as follows:—

A series of solid corrugated plates of cast iron, (or as mentioned below) with passages for admitting and discharging the juice, form so many separate chambers. The plates are supported on steel bars fixed at each side of the machine and are drawn together by a machine cut steel screw of large diameter which works in a gun metal nut secured in a steel crosshead. The end of the screw is provided with a capstan head and handle for running up quickly, the final pressure being put on with a capstan bar, sent with the machine.

The juice flows into a cast iron trough which is graduated to indicate the quantity filtered, and each press is complete with two sets of cloths, charging and drain cocks, air, water, and run off cock on trough. The extra cost of perforated copper or zinc plates will be found below.

PRICES OF FILTER PRESSES FOR JUICE.

Number of chambers	12	18	24
Prices of press with iron plates	£65	£80	£100
Do. do. copper plates	£68	£100	£125
Do. do. zinc plates	£72	£90	£112
Approximate weight .. .. tons	3	4	5

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

OIL FILTER PRESSES see **OIL MILL MACHINERY.**

DEFECATORS made of copper and fitted with steam inlet valve, air valve, steam trap with drain pipes and cocks, internal stand pipe and two way draw off cock.

PRICES OF DEFECATORS.

Capacity .. .. ..gallons	300	400	500	600	700	800
Diameter .. .. .. inches	56	62	66	72	78	84
Total depth .. .. inches	41	45	51	52	52	52
Price of defecator	£70	£85	£110	£115	£135	£160

The cost of the packing for shipment and delivery f.o.b. is 5 per cent.

ASPINAL EVAPORATING PANS.—The vessel is constructed of wrought iron or mild steel, the bottom is steam jacketted and is stayed to work with high pressure steam. The disc is of brass and is fitted with solid drawn brass tubes of 1½ in. diameter and a lifting shackle. The steam chest is of cast iron with steam tube and stop valve and the apparatus is complete with thermometer, steam trap, large sluice discharge valve, &c.

PRICES OF ASPINAL PANS.

Juice treated per hour, 10 to 25 Beaumé ..gallons	250	400	600	800
Diameter of disc .. .. inches	36	42	48	56
Depth of disc .. .. inches	8	10	12	15
Number of brass tubes 1½ inch diameter	190	250	350	480
Price of pan complete	£95	£130	£175	£235

The cost of packing for shipment and delivery f.o.b. is 6 per cent.

CENTRIFUGAL MACHINES, OR HYDRO EXTRACTORS, of the type illustrated by Fig. 6081 are an essential feature in sugar mill plant, and equally so in dye and bleach works, laundries and in many chemical and other processes which cannot be successfully conducted by any other mechanical appliance.

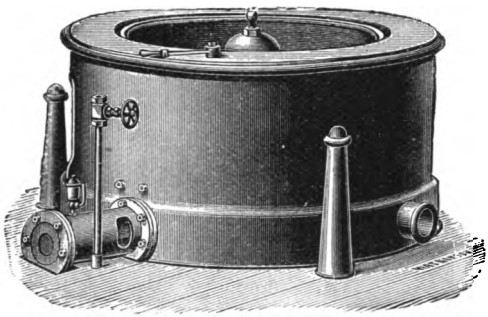


Fig. 6081.

These machines are arranged to be driven by belt from above or from below, by an engine attached to the frame or to the outer case which surrounds the revolving basket, or by one fixed below the case.

The last named construction has been selected for illustration because the moisture and other surroundings of hydro-extractors are usually unfavourable to the use of belts and the mode of driving from below as represented in the engraving, is rapidly superseding all others.

The perforated cage or basket, lined with metallic gauze, is revolved at a high speed inside the casing—in this case—by an accurately finished and balanced engine with the connecting rod on a crank at the lower end of the basket spindle.

The machine requires no foundation and may be worked on an upper floor and, if desired, a bottom discharge is provided through which the contents of the basket are delivered to a receptacle provided for the purpose, or they can be conducted away by a shoot, or other appropriate arrangement.

The subjoined prices refer to the type of machines in general use but many other arrangements are made to suit differing conditions as regards the work to be done, modes of fixing, driving, &c, for which special prices should be obtained.

The hand driven machines are adapted for laundries and for many processes where the work is intermittent and not beyond manual power.

PRICES OF HYDRO EXTRACTORS AND ENGINE AS FIG. 6081.

Diameter of basket ... ... inches	30	36	42	48
Price with galvanized steel basket	£84	£98	£116	£132
Price with copper plate and gauze basket	£90	£106	£126	£144

The cost of packing for shipment and delivery f.o.b. ranges from 5 to 8 per cent.

RECTANGULAR ELIMINATOR for sugar cane juice, is built up in cast iron plates with planed joints and provided with a rectangular coil of solid drawn copper pipes of 3½ in. diameter, stop valves respectively for fresh and exhaust steam, steam trap and connections. The fittings comprise discharge valve, plug valve for washing out sediment, and another in the scum gutter which surrounds the lip of the vessel.

PRICES OF RECTANGULAR ELIMINATORS.

Capacity ... ...gallons	400	500	600	700	800
Length of coil of 3½ inch pipes ... feet	52	62	75	87	100
Price of eliminator	£100	£120	£135	£150	£170
Approx. weight ... ... tons	2	2¼	2½	2¾	3

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

CYLINDRICAL ELIMINATORS constructed of wrought iron or mild steel plate and surrounded by a scum gutter. Solid drawn copper pipes are fixed near to the bottom of the vessel and it is complete with steam stop valve, steam trap and connecting tubes, plug valve in scum gutter, discharge valve and feet for fixing the vessel to the floor.

PRICES OF CIRCULAR ELIMINATORS.

Capacity of vessel	...gallons	400	500	600	700	800
Diameter	... inches	66	72	78	84	84
Depth	... inches	33	36	36	36	42
Heating surface	square feet	40	50	60	70	80
Price of eliminator	... ...	£50	£60	£70	£80	£90
Approximate measurement	... tons	3½	4	4½	5½	6½

The cost of packing for shipment and delivery f.o.b. is 5 per cent

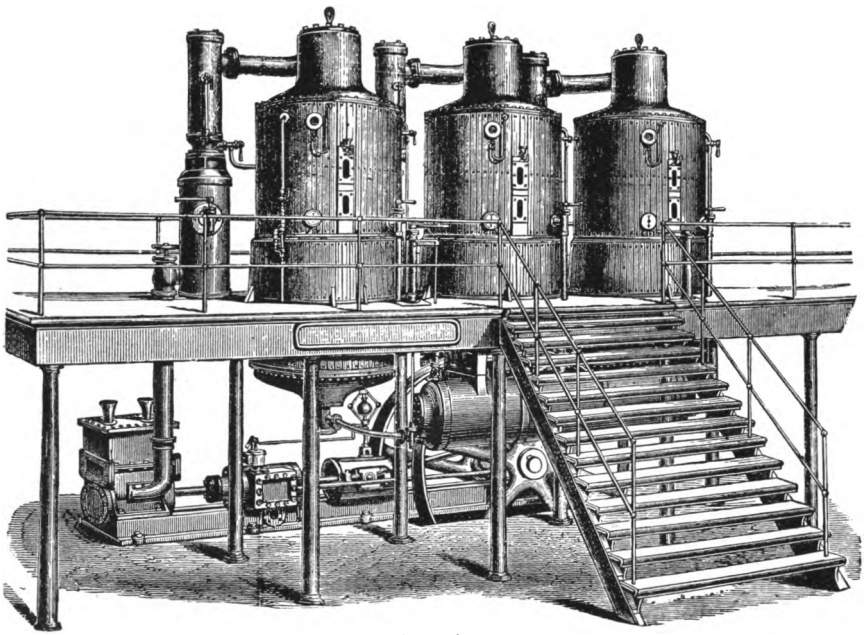


Fig. 6082.

TRIPLE EFFET EVAPORATING PANS.—Fig. 6082 represents the well known arrangement of triple effet for utilising the latent heat in the exhaust steam to evaporate the watery matter in the liquor, after it has supplied the motive power to the engines.

The vessels, arranged vertically as shown, are made of cast iron and are provided with tube plates and solid drawn brass tubes, doors, branches for connection with pumps, &c

The fittings for each vessel consist of charging and discharging cocks, pipes for syrup, steam, water and vapour, thermometer, vacuum gauge, test cocks, glass index cocks, sight tubes, air and steaming cocks, &c.; also pumps which draw off the water condensed in vessels number 2 and 3 and syrup from the latter.

A horizontal pumping engine, entirely self contained, is fixed beneath the stage which carries the triple effet vessels, and is complete with governors, equilibrium valve, throttle valve, and steam stop valve. The vacuum pump is fixed behind the steam cylinder, the pump rod is brass cased and the piston, pump barrel, valves and valve seats are of brass.

The Staging is constructed of iron and comprises the cast iron columns, wrought iron longitudinal and transverse girders, wrought iron hand rail, stairs to platform, bolts, nuts, &c.

HORIZONTAL TRIPLE EFFET.—This arrangement is sometimes regarded as possessing practical advantages over the more generally used type illustrated by Fig. 6082.

The vessels are made of wrought iron or mild steel and doors are provided for access to the tubes at both ends. They are complete with all accessories, and the engine, pumps, staging, &c. are as above described.

PRICE OF TRIPLE EFFET EVAPORATING PANS.

Gallons treated per hour 10° to 25 Beaumé	750	1050	1450	1650	2000	2400	3000
Heating surface ... square feet	1250	1800	2400	2700	3250	4000	5000
Price of vertical type	£1000	£1260	£1560	£1700	£1950	£2400	£3000
Price of horizontal type ...	£920	£1150	£1420	£1550	£1780	£2200	£2700
Price of engine...	£265	£350	£390	£420	£460	£525	£600
Price of staging	£125	£140	£155	£170	£200	£220	£240

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

VACUUM PANS.—The cylinder is fixed vertically and is made of cast iron, well felted and clothed with polished wood lagging. The condensor, safe and vapour pipes are also of cast iron and of ample proportion and the apparatus is complete with syrup charging cock and about 15 ft. of copper pipe, discharge valve, steaming and all other cocks, gauges, thermometer, injection cock and pipe and all necessary fittings.

The engine, vacuum pumps, staging, &c. are similar in design and construction to those last described.

PRICES OF VACUUM PANS.

Capacity .. cubic feet	48	66	84	110	133	160	250	300
Heating surface.. square feet	72	100	126	132	166	200	312	380
Dry sugar cwts. per shoot	1	1½	2	2½	3	4	6	7½
Price of pan	£260	£285	£385	£430	£515	£605	£760	£840
Price of engine	£160	£190	£240	£265	£350	£390	£465	£525
Price of staging	£65	£75	£85	£95	£100	£110	£122	£130

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

WETZEL EVAPORATING PANS.—In both the horizontal and helical coil arrangements referred to below, the pan and coil are constructed of copper and the latter is revolved by gear with suitable shafts and end bearings. The following prices are for belt driven machines but, if preferred, they can be driven by a small independent engine and are made, in either case, with or without a syrup pump carried by the end frame.

In the horizontal arrangement the copper pipes are secured in a hollow copper disc to which a cast iron trunnion is fitted to admit and discharge steam centrally.

The helical coil pipes are fixed in a similar manner, and both the machines are complete with steam supply and discharge valves, air and safety valve, brass slide valve for emptying sugar, drain tubes, fast and loose pulley, foundation bolts, &c.

PRICE OF WETZEL PANS.

Length of pan	9ft.	9ft. 4in.
Width of pan	4ft. 2in.	5ft.
Depth of pan	1ft. 2in.	1ft. 6in.
Price with horizontal tubes	£140	£155
Price with helical tubes	£120	£135

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

DISTILLING APPARATUS.—That represented by Fig. 6083 will be recognized as a type largely used in connection with sugar mills. Those working on the continuous system will be referred to later on.

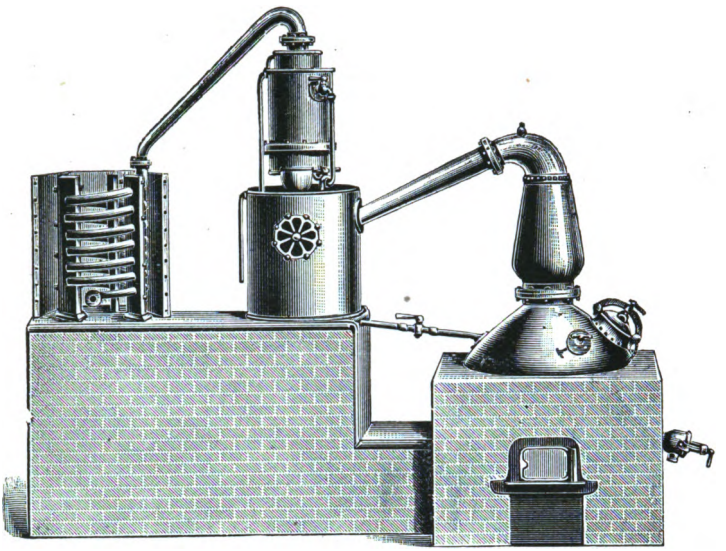


Fig. 6083.

RUM STILL, RETORT, RECTIFIER AND REFRIGERATOR.—Fig. 6083 represents the copper still as generally fixed and the apparatus consists of the retort with glass index, return cock and pipe to still, charging valve, discharge cock, air valve, brass man hole, frame and door and a complete set of fittings for the furnace.

The rectifying appliances are complete with water cock and pipes; the refrigerating coil is of copper and is placed in a wood tank, usually made by the purchaser and not included in the following prices.

PRICES OF RUM STILLS, Fig. 6083.

Capacity in gallons	150	200	300	400	500	600	800	1000
Price of still	£160	£183	£260	£310	£360	£450	£560	£700

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

RUM STILL WITHOUT RECTIFIER.—This is generally similar to that illustrated by Fig. 6083 and last described, excepting that the refrigerating vessel is where the rectifier is shown and receives the wash direct from the retort.

PRICES OF RUM STILLS AND REFRIGERATORS.

Capacity in gallons	50	60	80	100	150	200	250	300
Price of apparatus	£50	£55	£60	£70	£100	£125	£165	£185

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

CONTINUOUS SYSTEM STEAM STILLS.—Limited space prevents even a bare reference to the numerous methods adopted in continuous distillation, but that briefly described is a useful and successful type; stills of larger capacity and more elaborate arrangement must be subjects for special consideration and estimate.

The still consists of a copper steam chamber surmounted by a cylindrical column made of copper, with copper division plates, dip plates, pans and brass valves, copper safe, tubular wash heater and tubular condensor.

The apparatus is fitted with an automatic steam regulating valve and perforated copper steam pipe, index cock, manway, handway for each section, air valve, run off cock, thermometer, glass proof jar and cock at spirit outlet.

PRICES OF CONTINUOUS STILLS.

Run of wash per hour ... ...gallons	100	150	200	300	400	500	600
Price of still	£310	£375	£460	£620	£710	£810	£900
Ditto engine and pump	£90	£115	£140	£165	£195	£225	£245

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

COFFEE DRESSING MACHINERY.

The freshly gathered coffee berries are first passed through the pulper—illustrated by Fig. 6090—which removes the fleshy matter and delivers the berries with the parchment-like skin adhering to them.

The next operation is to soak the beans in water, which should be agitated occasionally, to aid in removing any fleshy or gummy matter which may still remain.

After this, the beans are exposed in the sun and, when thoroughly dried, they are taken to a husking machine—illustrated by Fig 6091—which removes the skin above referred to and leaves them ready for cleaning and classifying.

The cleaning is effected in a vanner of the type Fig. 6097 which drives away the refuse, and leaves the beans ready for classification into three, four or five sizes or qualities.

The classification is sometimes done by hand sieving, in others by a separate machine, or the vanning and classifying are performed by one machine, as will be referred to later on. In either case the beans are automatically delivered into the bins appropriated for the several sizes and qualities.

A further process, that of washing, is now frequently added, to cleanse the product of all extraneous matter and so increase its market value.

Timber frames for some of the machines can be constructed at destination, the machinery only being sent from this country, but in most cases the complete machines will—in the long run—be found quite as economical and satisfactory.

THE COFFEE PULPER, Fig. 6090 has an iron frame which carries all the driving gear and an iron cylinder covered with serrated copper which revolves near to a breast plate, but not in contact with it.

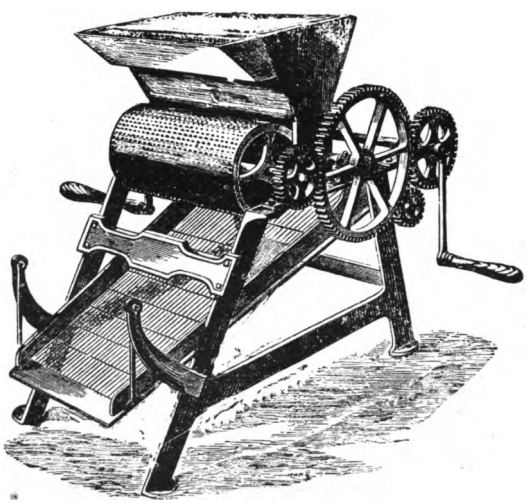


Fig. 6090.

The berries are fed into the hopper and this is supplied with water in which they float, heavier substances, such as stones, &c. which would injure the copper covered cylinder, falling to the bottom. The berries float forward until they come in contact with the revolving cylinder and breast plate which strips off the pulpy matter and conduct it away, the berries being delivered into a receptacle below the screen.

The output of the machine, when worked by two men is is about 30 bushels of ripe coffee per hour, and it is easily moved from place to place.

If the machine is driven by cattle or other power, the above-named output is largely exceeded.

The price of a small machine complete with handles is £23 0 0
Do. do. do. do. with adjustable breast plate £24 10 0
Do. do. machine as Fig. 6090 to work by manual power is £37 10 0
If fitted with an adjustable breast plate add 10 per cent.
If with pulley to work by power add 5 per cent.
The price of cattle gear to drive the machine is £15 10 0.
Packing for shipment and delivery f.o.b. costs 5 per cent.

DISC PULPERS are constructed with a view to facility for transport and are made in two sizes. The quantities mentioned are turned out by manual labour; if the machines are driven by power the yield is far larger and superior in quality.

The machines are complete with handles and a spare set of copper discs.
The price of a single machine to pulp 30 bushels per hour is £24 0 0
Ditto double do. do. 60 bushels do. £35 0 0
Ditto for cattle gear to drive either machine £17 10 0
If with pulleys to work by power, add 5 per cent.
The cost of packing for shipment and delivery f.o.b. is 5 per cent.

COFFEE HUSKING PLANTS for a large output are constructed (with the necessary modifications) on the principles indicated in Fig 6091, and may be driven by a turbine, water wheel, or other motive power.

The approximate cost of the machinery to husk 5 to 6 tons in a day of 10 hours, including an undershot water wheel, shafting, bearings, spur wheels, &c. to drive the machine is £150.

The approximate weight is 5½ tons and the cost of packing for shipment and delivery f.o.b. is 5 per cent.

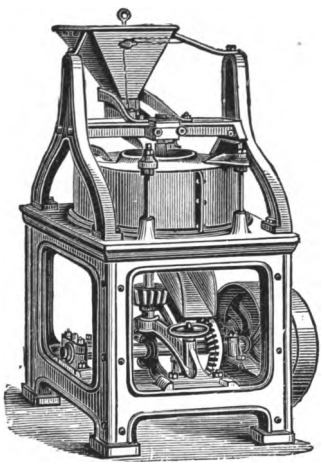


Fig. 6091.

THE "RETRILEA" OR HUSKING MACHINE is of the type shown in Fig. 6091. The stones revolve in opposite directions and appliances are provided for adjusting the space between them, to suit the variations in the products.

POWER DRIVEN HUSKING MACHINES illustrated by Fig. 6091, have the driving gear carried in the main frame below the revolving stones. The machines are entirely self contained and are complete with appliances for adjusting the space between the stones, fast and loose pulleys, &c. The undernamed approximate output is obtained when the driven pulley makes about 50 revolutions per minute.

HAND POWER HUSKING MILLS.—The arrangement of stones, the adjustments, &c. are precisely the same as those in the machines last referred to, but the driving gear is above instead of being below as shown in the engraving, in order to bring the handles to a convenient height for turning. The handles, may at any time, be removed and a pulley keyed on the shaft for driving by belt, in conjunction with the other machines.

PRICES OF POWER DRIVEN HUSKING MACHINES, Fig. 6091.

Diameter of stones ... ... inches	22	24
Approximate output per hour ... ... lbs.	220	330
Price of machine	£30	£33
Ditto cattle gear and connections	£15	£17
Horse power required	½	1
Approximate measurement ... cubic feet	35	40

The cost of packing for shipment and delivery f.o.b. is 7 per cent.

PRICES OF HAND POWER HUSKING MACHINES.

Diameter of stones .. .. .. inches	20	22	24
Approximate output per hour .. .. lbs.	112	160	220
Price of machine	£22	£25	£28
Man power required	1	2	3
Approximate measurement .. cubic feet	32	35	40

The cost of packing for shipment and delivery f.o.b. is 7 per cent.

THE VANNER as illustrated by Fig. 6097 among Rice Treating Machinery, consists of a timber or iron frame containing a fan and three perforated zinc gigging trays. The fan is of the power required to drive away the light particles and the cleansing operation is completed by the beans travelling over the perforated screens, from which they are delivered ready for classifying, or for sending to market without classification.

The yield from these machines, worked by hand power, is large and the subjoined prices are for timber frames and hand power, excepting the 30 in. size which is constructed to work by steam power.

PRICES OF VANNERS as Fig. 6097.

Width of machine	22in.	24in.	27in.	30in.
Price of machine	£9 15 0	£10 15 0	£14 15 0	£23 10 0
Cost of packing, &c.	£1 1 0	£1 5 0	£1 13 0	£2 5 0

VANNER AND CLASSIFIER.—The mechanism for cleansing the berry is similar to that last described but, in this case, it is used in conjunction with a revolving cylinder into which the berries are delivered from the vanner and classified in their respective marketable qualities.

The machine, complete, is carried in a strong timber frame with divisions for the four or five separations required, so that the different categories are automatically deposited in their respective places ready to be stored or delivered.

The machines of 20 inches diameter are worked by hand power and will clasify about two tons of coffee per hour. Those of 30 inches diameter are constructed to work by steam power at an extra cost of 10 per cent. and will treat about four tons of coffee per hour.

PRICES OF VANNING AND CLASSIFYING MACHINES.

Diameter of cylinder	20in.	20in.	30in.	30in.
Length of cylinder	6ft. 9in.	7ft. 6in.	7ft.	8ft.
Number of separations	4	4	5	5
Price of machine	£29 10 0	£32 0 0	£44 0 0	£55 0 0
Approx. measurement, cubic feet	145	150	220	270

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

THE MACHINERY ONLY FOR CLASSIFIERS, for 3, 4 or 5 separations is made, ready for mounting on frames provided by the purchases in cases where it is desirable to effect a saving in freight, import duties and inland transport charges.

The cost of the ironwork and machinery varies from about £15 to £50 and it consists of the separating cylinder, shaft, pedestals with gun metal bearings, appliances for adjusting the cylinder, fly wheel and handle, brush spindle with cleaning brush and bearings, delivery shoot, &c.

COFFEE WASHING MACHINES.—The market price of the beans being considerably enhanced if they are washed and delivered free from dust and all refuse, machines for this purpose are largely used by enterprising exporters.

The machine consists of a horizontal wrought iron cylinder with central shaft carried in a wrought iron frame and provided with a feed hopper.

The central shaft has a series of arms throughout its length and a driving pulley on one end. This shaft being revolved and beans fed into the cylinder, which is supplied with water, they are completely cleansed from any refuse which may remain on them after treatment in the other machines, and are automatically delivered ready for market.

The driving power is very small and the price of the machine complete with hopper, discharge door, and driving pulley is £21.

The cost of packing for shipment and delivery f.o.b. is 7 per cent.

RICE MACHINERY.

Whether the treatment of rice is carried out on a large scale, as in the extensive and admirably equipped mills so well known in the East, or on the smaller scale indicated in the engraving Fig. 6095, which represents one of many installations in constant and successful use,

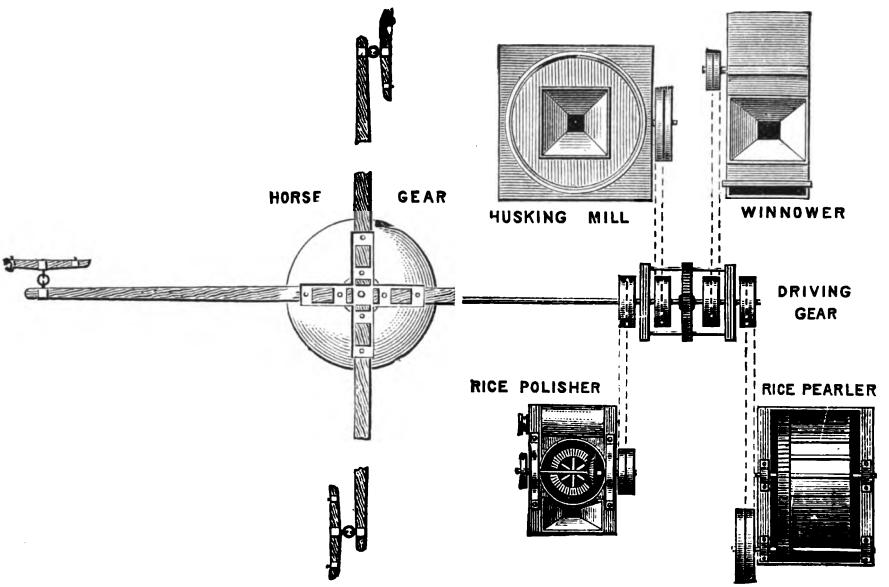


Fig. 6095.

the principles of treatment are essentially the same, although in large mills many appliances are used for reducing the cost of manual labour, fuel, &c. and for improving the appearance of the grain, which cannot be profitably employed in smaller installations

Owing to the great variations in the extent, the arrangement and the details of equipment, it is impossible to describe these large mills, and the following remarks must be limited to a general description of some installations of more moderate capacity and, subsequently. of the types of machines used in them.

Reverting to the treatment of rice after the grain has been separated from the straw, the husking mill loosens the husk which is driven away by the winnowing machine.

In this state the rice is fit for delivery to some Eastern markets, but for producing the white table rice suitable for export to Europe, the grains must be decorticated in a pearling mill and, finally, polished in the machine specially designed for that purpose.

The approximate estimates of cost and of daily output, referred to in the following outline specifications, are based on 12 hours work under competent supervision, and the cost of packing for shipment and delivery f.o.b. will vary from 5 to 7½ per cent. on the cost of plant.

PLANT TO TREAT FIVE TONS OF RICE in 12 hours will comprise:—A hexagon screen, a vertical smutting machine, a husking mill, pearling mill, vertical brushing machine, polishing machine, separating machine, three elevators with leather bands, elevator cups and cast iron head for each elevator, also a sack hoist with brake and all accessories.

The cost of the plant with the requisite shafting for driving the whole of the machinery, pedestals with hard gun metal bearings, pulleys, leather driving bands, laces, &c. is £810.

The price of a horizontal non-condensing steam engine of the type Fig. 1507 and Cornish or multitubular boiler, of ample capacity for driving the whole plant, with all furnace, steam and feed water fittings and pipe connections to the engine and for exhaust, is £280.

PLANT TO TREAT ONE TON OF RICE in 12 hours will comprise:—A husking mill with crane for lifting the stone for dressing, winnowing machine, pearling mill, brushing machine, polishing machine, separating machine, two elevators with bands and cups and head for each elevator, shafting and pedestals, pulleys, leather driving belts, laces, &c., for driving the whole of the machinery.

The approximate cost of this plant is £325.

The price of a vertical steam engine and boiler of the type Fig. 1511 with base plate forming a feed water tank, the boiler lagged, felted and covered with sheet iron is £95 5 0.

A plant similar to the above but driven by horse gear with intermediate motion, shafting, pulleys, driving belts, &c. as above and without elevators and other accessories, not required for cattle driven plant, costs about £245.

PLANT TO TREAT HALF-A-TON of rice per day of 12 hours comprises :—a husking mill, winnowing machine for manual power with separating sieves, pearling machine with automatic feed, brushing and dressing machine, horse gear with intermediate motion, shafting, bearings, pulleys, leather belting, &c. for driving the machines.

The approximate cost of this plant is £190.

PORTABLE RICE THRASHING MACHINES, worked by power, are provided with wheels, axles and oil boxes, swivelling fore carriage, &c. and are similar (with some modifications) to those used for thrashing and dressing grain in this and other countries. The machines referred to in the accompanying list of prices give a second dressing and deliver the products, with a superior finish, at one operation.

PRICES OF THRASHING MACHINES WORKED BY POWER.

Horse power required	3	6	10
Price of machine	£105	£135	£160

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

RICE THRASHING MACHINES worked by manual power, or driven from horse gear, with feeding table and handles vary in price from £12 to £14.

If with extra long shaking tables add £5 to £6.

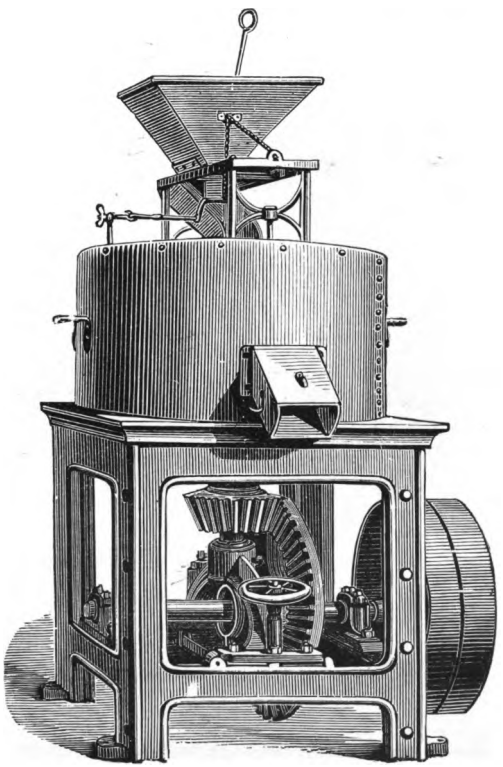


Fig. 6096.

POWER DRIVEN RICE HUSKING MILL as represented by Fig. 6096 consists of a strong iron frame which carries the driving gear and the whole of the machinery.

The lower millstone is fixed on the top table and the upper stone is revolved by the gear below the table, the space between the stones being regulated by a screw and hand wheel, as shown.

The rice is fed, through the hopper, into the casing which surrounds the stones and—when the husk has been sufficiently loosened—the rice is delivered through the spout and is transferred to the winnowing machine which drives off the loose husk and other light particles.

When the top stone requires dressing, the wrought iron casing is removed and the stone is lifted by a crane (not shown in the engraving) which replaces it in position, when dressed.

As will be seen from the engraving and description, each mill is complete in itself and may be used singly or in series, additions being made, to any extent desired, without deranging the existing plant.

For cost of millstone dressing tools see page 33.

POWER DRIVEN HUSKING MILLS, Fig. 6096.

Diameter of stones	24in.	30in.	36in.	42in.	48in.	60in.
Price of mill	£30 15	£40	£50	£65	£73	£100
Price of stone crane	£5 10	£5 15	£6 10	£7	£7 15	£12 10
Price of loose pulley	£1 7 6	£1 18	£2 15	£3	£3 5	£4 15
Horse power required	1	1½	2	3	4	6
Approx. measurement, cubic feet	36	60	80	100	150	200

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

HAND DRIVEN HUSKING MILLS are constructed on the same principles as those working by power, Fig. 6096, but the driving gear is carried in iron frames above, instead of being below the table.

These mills turn out a fair sample of grain but not equal to that produced by the power driven mills and, if the rice is too hard to be husked at one operation, the output must be expected to be less than is stated in the subjoined list.

HAND DRIVEN HUSKING MILLS.

Diameter of stones	20in.	22in.	24in.
Price of mill	£25 5 0	£27 10 0	£29 10 0
Power required men	2	3	4
Approximate output per day lbs.	560	780	1100
Approximate measurement cubic feet	30	35	45

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

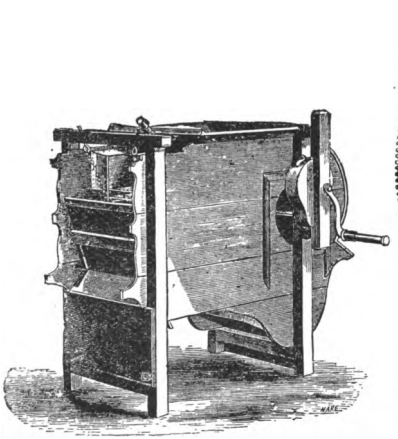


Fig 6097.

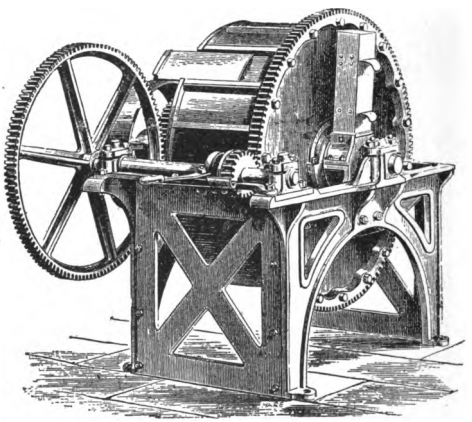


Fig. 6098.

Winnowing Machines of the type Fig 6097 drive off the chaff, &c., after the husking process and deliver the rice ready for treatment in the pearling mill.

It is more profitable to drive the larger sizes by power and they are provided with a turned pulley instead of the handle at a small extra cost.

WINNOWING MACHINES, as Fig. 6097.

Width of machine	18in.	20in.	22in.	30in.
Price of machine	£8 0 0	£10 10 0	£11 10 0	£12 10 0
Packing for shipment	£1 7 0	£1 12 6	£2 0 0	£2 7 6

PEARLING MILLS as illustrated by Fig. 6098 decorticate the rice and deliver the white grains freed from the cuticle.

The frame is of iron and carries the driving gear and the stone which is surrounded by an iron case as shown.

The rice is fed into the casing as it leaves the winnowing machine, and the feed shoot has two slides for regulating the supply. The stone is secured to the spindle, which is driven by belt pulley and is carried in long gun metal bearings; the interior of the case is provided with steel wire gauze, which revolves in the same direction as the stone and allows the dust to escape. When the rice has been decorticated, it is delivered through a slide in the case and is then ready for polishing.

PRICES OF PEARLING MILLS, Fig. 6098.

Diameter of stone	30in.	33in.	36in.	39in.	42in.
Price of mill	£52	£62	£73	£84	£112
Horse power required	2	2½	3	4	5
Approximate output per day ... tons	1	1¼	1½	1¾	2

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

HAND POWER PEARLING MILLS are made on the same principles as the power driven mills, and (worked by two men) are capable of pearling about 160 lbs. of rice per day.

These mills are carried on iron frames and are complete with hopper, handles, &c., and the price is £28 5 0.

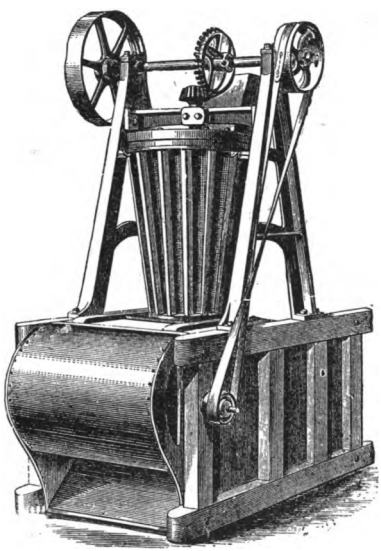


Fig. 6099.

RICE POLISHING MACHINE Fig. 6099.—This machine further cleans the grains and produces the bright appearance which well dressed rice should have.

The hopper conducts the rice into a specially constructed conical drum which revolves inside a wire gauze cylinder, when polished it descends to the fan, driven by belt, as shown, which expels the dust and delivers the rice ready for the final process of separation.

For large installations the form of this machine is frequently modified and, in many cases, it is constructed in accordance with designs or suggestions made by the mill manager whose experience in the preparation of rice for the markets in which it is sold, is often of great service alike to the proprietors of the mills and the makers of the machinery. Suggestions from these sources will always be carefully considered.

PRICES OF RICE POLISHING MACHINES, Fig. 6099.

Approximate output per day ... cwts.	7	15	25	35	45
Price of machine	£40	£47	£58	£80	£100
Horse power required	½	1	1½	2	3

The cost of packing for shipment and delivery f.o.b. varies from 5 to 7½ per cent.

RICE SEPARATORS generally resemble the winnower, Fig. 6097, and are used merely to remove the broken and undersized grains and to produce a good marketable sample.

PRICES OF RICE SEPARATORS.

Width of machine	16in.	18in.	20in.	22in.	30in.
Price of machine	£9 0 0	£10 0 0	£11 0 0	£12 10 0	£19 10 0
Cost of packing	£1 2 6	£1 7 6	£1 12 6	£2 0 0	£2 7 6

COTTON AND FIBRE MACHINERY.

GINNING AND BALING FACTORIES must necessarily be arranged to suit conditions peculiar to each case, such as the quantity to be dealt with in a given time, the buildings (if any) available for the factory, the amount of capital at command, and so forth. These vary very widely but the following suggestions with regard to general arrangement of such a factory, which will be economical in cost of construction, in supervision and maintenance, may be useful whether the number of gins be 35 (as in this case) or almost any other number.

The ginning plant under consideration—details of which will be found further on—is arranged to occupy a single storey building about 140 ft. long and 24 ft. wide; the opener room adjoins the gin room, with access to each opening machine for the cotton arriving from the fields, and from them to the gin room.

The engine room and boiler house are at one end and the hydraulic pumps to supply the baling presses are in the engine room.

The floors of the gin and opener rooms are about 8 ft. above ground level; the shafting, main driving pulleys, &c. fixed in this basement are therefore quite accessible for examination, and the only straps in the gin and opener rooms are close to the floor, and entirely protected.

The plant consists of two 50 in. openers, thirty-five 40 in. double acting self feeding Macarthy gins, about 130 ft. of steel main driving shaft with couplings, pedestal bearings, pulleys, &c., a total of about 1,100 ft. of leather belting, spare laces, &c.

The engines are of the compound condensing type of 85 nominal h.p. The steam supply is taken from two Lancashire boilers to work at a pressure of 85 lbs. per square inch and complete with all fittings and connections, donkey feed pump to each boiler and an injector in reserve.

The hydraulic pumps (see Fig. 6127) are of the proportions required to supply two hydraulic baling presses with run out boxes in duplicate, rails, &c., conveniently placed for receiving the ginned cotton and delivering the bales.

The hydraulic presses are of the type illustrated by Fig. 6127.

The engine room outfit comprises the usual artificers tools, and includes a self acting screw cutting lathe for trueing up parts requiring attention and for general work, a drilling machine and a machine to screw pipes, bolts, nuts, &c.

The cost of the plant and machinery as above described (at the present price of materials) is £3385, and the cost of packing for shipment and delivery f.o.b. is 5 per cent.

The approximate total weight is 135 tons but for estimating the cost of freight, it may be assumed that, in weight and measurement, the total will be about 250 tons.

Baling presses see Figs. 6127 to 6137.

COTTON OPENERS AND COTTON GINS.—If there should be any doubt as to the machines referred to in the following pages being completely suitable for the cotton to be worked, a fair average sample of it should be supplied, with the seeds undisturbed, together with information relating to the quantity to be treated in a given time, and any other details which will aid towards determining the types of machines to be made.

With a view of avoiding loss of time in correspondence, details are given of the space occupied by machines in general use and suitable for most kinds of cotton, the power required to drive them, the separate cost of accessories and some indications in regard to arranging and fixing cotton ginning plant, which will be supplemented by such further information as may be desired.

COTTON OPENING MACHINE.—The two cylinders, fan and delivery apparatus are carried in a substantial cast iron frame, complete with the appliances for opening the cotton ready for the gins; one 50 in. machine will supply about 16 gins.

The price of the machine is	£61 10 0
Straps (exclusive of main driving belt)	£1 10 0
Screw keys and screw driver	£0 5 6
Packing for shipment and delivery f.o.b.	£6 10 0

DOUBLE MACARTHY COTTON GINS are adapted for cleaning all kinds of cotton especially those which have the husk covered with short fibre ("woolly seed"). The output of this class of cotton is about 120 lbs. per gin per hour, but a larger out-turn is obtained with other varieties of cotton which do not adhere so tenaciously to the seed. The machine is perfectly self feeding no attention being required after the cotton has been placed in the hopper, the rollers last longer than those in other machines and they are so arranged that extraneous matter is passed through without causing inconvenience.

The price of the machine with two wood rollers 6 in. diam. covered with leather, strap guide, needle lubricators, &c. is	£37 10 0
Straps (exclusive of main driving belt)	£1 0 0
Set of screw keys and screw driver	£0 10 6
Packing for shipment and delivery f.o.b. about ...	£4 5 0

The power required to drive the machine is about 2½ indicated h.p. and the floor space occupied is 6 ft. 3 in. by 4 ft. 4 in. The measurement, as packed for shipment, is about 71 cubic feet.

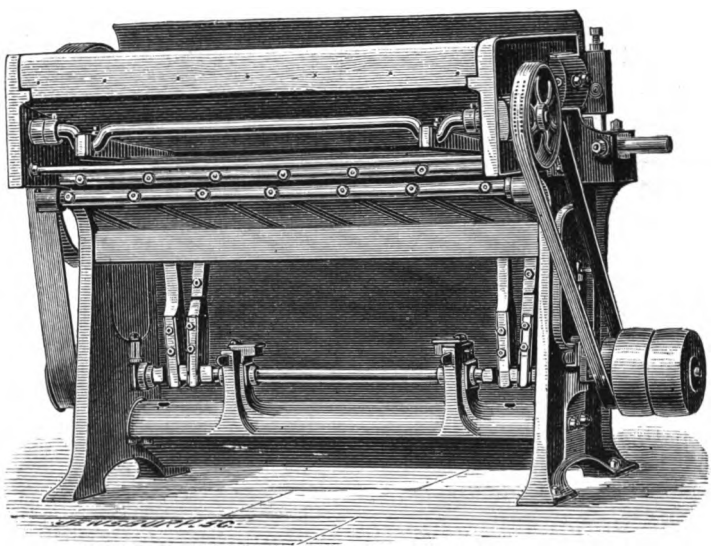


Fig. 6103.

DOUBLE ACTING SELF FEEDING MACARTHY GINS illustrated by Fig. 6103, will gin and separate the seeds from most kinds of cotton, including that grown from native Indian seed, without crushing the seed or injuring the fibre.

The machines have self acting feed and each revolution of the crank shaft gives two strokes of the ginning knife. The knives balance each other, the motion therefore is steady and, although the speed of working is low, the output of Surat, Smyrna, or other short staple varieties is 30 to 35 lbs. of cleaned cotton per hour for each machine.

As usually made, the machines are 40 in. wide, the crank shaft is 1¼ in. diameter carried in four bearings, the rollers are 6 in. diameter and covered with walrus leather, and the machine is complete with loose and fast driving pulley.

SINGLE ACTING SELF FEEDING MACARTHY GINS are generally similar to those illustrated by Fig. 6103, but have single instead of double acting motions.

The machines are 40 in. wide with self feeding apparatus and will gin black or woolly seeds but are best adapted for long staple varieties. The seeds are separated without being crushed, and the output of Egyptian is 40 to 50 lbs. of cleaned cotton, per hour, and of Sea Island and other long staples about 60 lbs. per hour.

PRICES OF COTTON GINS AS Fig. 6103.

Type of machine	DOUBLE ACTING	SINGLE ACTING
Price of do.	£20 2 6	£18 5 0
Straps for ginning motion	£0 6 0	£0 6 0
Ditto feeding do.	£0 3 0	£0 3 0
Screw keys and screw driver	£0 6 0	£0 6 0
Indicated h.p. required	1½	1
Floor space occupied	5 ft. by 3 ft. 4 in.	5 ft. by 3 ft. 4 in.
Approximate measurement ... cubic feet	40	38
Packing and delivery f.o.b....	£2 10 0	£2 7 6

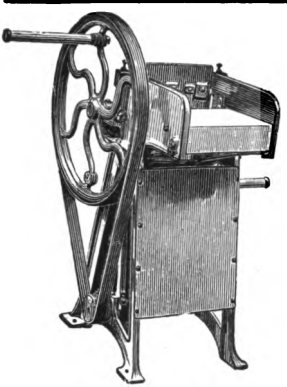


Fig. 6104.

HAND OR STEAM POWER DOUBLE ACTING MACARTHY GINS.—Fig. 6104 illustrates the machine, 12 in. wide, as worked by manual power, one man working the crank handle and the other with one hand on the fly wheel handle and feeding the cotton with the right hand. But if fitted with a pulley, in lieu of the arrangement shown, the machine may be worked by steam or other motive power and will gin any kind of cotton; the production, when worked by hand—according to the class—is about 8 to 12 lbs. of cleaned cotton per hour.

The price of the machine with fly wheel and handles is	£8 2 6
Leather straps	£0 5 0
Screw keys and screw driver	£0 6 0
Pulley to work by power	£0 8 0
Packing for shipment and delivery f.o.b. ...	£0 14 6

The measurement as packed is about 19 cubic feet and the floor space occupied is 3 ft. 9 in. by 2 ft. 9 in.

FLAX DRESSING MACHINES as distinguished from the ancient implements worked by hand, are the Breaker, the Scutcher, and the Comber. They are all carried in cast iron frames with pulleys and accessories for driving by power and produce a better sample, with a much larger output and less waste, than is realised by the old process.

The breaker loosens and partially detaches the woody part of the retted straw, by passing it between five pairs of cylindrical horizontal rollers, fluted radially at a differential pitch, and revolving at different speeds. The effect of this ingenious device is to completely remove and drive off the woody fibre, and leave the flax ready for scutching.

The machine is capable of treating about 1½ tons of flax straw per day and the yield of flax, per ton of straw, is from 50 to 70 lbs. more than is obtained by ordinary treatment.

The scutcher is constructed on the parallel roller system with carriers of the endless band type. The teeth point upwards and the flax, as it leaves the breaker, is fed into the carriers which return it to where it has been fed in, thoroughly cleansed.

The machine treats about 1½ tons of flax straw per day, and yields 7 to 8 cwt. of clean fibre.

The price of the breaker is £60 0 0
Ditto scutcher is £130 0 0

An engine of five nominal horse power will drive the two machines, and three men and five boys are required to work them.

The comber takes out the short fibre and impurities from the sliver and separates the long fibre for fine spinning, from the waste which is used for coarse counts, making felt, paper, &c.

The output of each comber is about 125 lbs. of sliver per day and the price is £170 0 0
One horse power is required to drive it and one girl can attend to three machines.

HEMP DRESSING MACHINES are similar in construction and arrangement to those used for flax dressing, as last described, but the proportions, &c., are modified to adapt them for the heavier work and the prices are as follows:—

Hemp breaking machine £78 0 0
Do. scutching do. £165 0 0
Do. combing do. £175 0 0

The cost of packing for shipment and delivery f.o.b. may be estimated at 10 per cent.

CHINA GRASS (RHEA) DRESSING MACHINES. A modification in the combing machines seems to have entirely overcome the difficulties hitherto experienced in successfully treating this delicate and beautiful fibre. Machines for this purpose can now be supplied which produce the fibre satisfactory alike in quantity and quality, and at prices not varying, materially, from those to which reference has been made.

FIBRE DRESSING MACHINES for preparing different kinds of vegetable fibres for shipment and for use, with or without further treatment, are so diversified in design and arrangement that only a few of them can be specially referred to.

Designs for appliances for preparing fibres hitherto unused, or requiring treatment differing from that now employed, are constantly being made, and such subjects will be carefully considered if full information thereon is supplied, together with specimens of the fibre and a description of the present method (if such exists) of treatment.

In addition to this, information should be given on the quantity to be handled in a given time, the quality of labour available, and its cost, the temperature and abundance or otherwise of the water required for wet processes, and any other facts to which attention should be directed.

COCOA NUT PRODUCTS.—The machines about to be referred to for crushing the husks, extracting the fibre and preparing it for market or for further treatment, have been perfected in design and proportions after practical experience in working them—extending over many years—and they are unquestionably superior to those commonly constructed.

Several other appliances are required for the finer separations and for the final treatment of some portions of products obtained from the cocoa nut. Amongst these may be mentioned the machinery for producing "Kopra," &c., for which see "Oil Mill Machinery." But those for pairing and slicing the nut and dessicating it for domestic use and for some other processes, must be adapted to the conditions peculiar to each case and are, therefore, subjects for special consideration and estimate.

A member of the Writer's firm who has had a lengthened practical experience in designing and working machinery for these purposes and for dressing various fibres will advise thereon, if desired.

COCOA NUT FIBRE PLANT.—In this, as in most other branches of manufacture, the larger the plant the lower should be the cost of production, and, to a certain extent, the evenness in the quality of the produce. This remark applies to the two sets of plant referred to below, the working expenses of the factory to deal with about 800 to 900 husks a day of 10 hours, being, relatively, lower than that dealing with 450 to 500 per day.

Whether the output reaches or exceeds these figures depends largely on the size of the husks and their condition when they are taken from the soaking tanks to the machines, but the numbers above referred to may be regarded as being fairly average.

The first operation, after the husks have been quartered and, before or after they have been soaked in water, is to flatten them out by passing them between the rolls of the crushing machines. The next is to remove the hard outer shell in the breaking down machines; the insiding machines take out the inner part of the husk and this is then ready for treatment in the cleaning machine. The dust is got rid of in the screening machines and, when this has been done, the fibre is ready for further treatment or for packing, as may be required.

The packing press comprised in the following approximate estimate is worked by a powerful screw, and makes two ballots (small bales) at a time, and is complete with improved appliances for disengaging the ballots. But, as is well known, the reduction in the dimensions of bales made by a hydraulic press (the extra cost of which is stated) effects a permanent and important saving in freight, and correspondingly reduces the total cost of the produce when delivered at distant markets.

The machinery above described, to treat about 800 to 900 husks per day, including the main driving shaft, bearings, pulleys, straps, &c., to work all the machines costs about £700.

If with steam engine, boiler, &c., the cost is about	£955.
A plant to treat 450 to 500 husks per day costs about	£450.
Or complete with engine, boiler, &c., about	£710.
Extra for a hydraulic press (see description further on) in lieu of a screw press	£65.

A gas or oil engine (see Section 1), can be used instead of the steam engine and boiler, and the extra cost will probably be about 6 per cent.

The cost of packing for shipment and delivery f.o.b. is about 7½ per cent.

MACHINES FOR FIBRE FACTORIES.—Space does not admit of these being illustrated and described in detail, but mention may be made of those in common use, such as—

Fibre opening machines for opening out cocoa nut (coir) or other fibre, as it comes from the bale and requires preparation for other processes. Three sizes are made and they vary in price from about £75 to £95.

Fibre spinning machine for producing rope yarns from coir or other fibres, and to be worked by one, two, six, or ten girls, range in price from £30 to £160.

Braiding machines, which make a flat plait or braid from fibre yarns. The prices vary according to the number of bobbins, from £25 to £40.

Winding Machines to wind yarns on to 4 to 12 bobbins simultaneously. The cost ranges from £24 to £45.

Singeing machine, to remove the short projecting fibres with reel stand, rollers and burner, costs £35.

Power looms to weave matting from 40 to 80 inches wide, range in price from £65 to £90.

In large factories other machines are required, such as **Shearing machines, Combing machines, Measuring and Coiling machines, etc.**

ROPE MAKING MACHINERY.—Some of the appliances referred to in general terms in the articles on "machines for fibre factories" (see ante)—with some modifications which do not materially affect the price—are employed for making ropes and twines from **hemp** of the different varieties, **flax, jute, Mexican fibre,** etc. The prices of these appliances are not given separately because those who are not practically acquainted with rope making and with the machines themselves, might find it difficult to determine in what proportions they should be provided to obtain the daily or weekly output required.

The following description of a rope making plant (together with the information contained in the previous article) will however serve as a basis for approximately estimating the cost of the machinery requisite for a factory for an output differing from that specially referred to.

A ROPE MAKING FACTORY with the appliances requisite for dressing the hemp and for producing 1000 fathoms (6000 feet) per day of rope 3 inches circumference or equivalently larger quantities of other sizes down to about 1½ inch circumference, or smaller quantities up to about 5 inches circumference, comprises :—

Two sets of Heckles, each set including coarse and fine ruffers and hemp kegs, for separating the fibres from the waste and dressing ready for spinning—6 or 8 hands required.

Twelve Patent Spinning Machines, with 20 bobbins for each machine, and the latest improvements which give the spinner perfect control over twisting the fibre and producing a right hand or left hand twist. A girl works each machine.

A Horizontal Hemp Rope Stranding Machine for bobbins 27 inches diameter, wrought iron bobbin frame or flyer, change tubes for different sizes of strands, change wheels for varying the extent of twist, apparatus indicating the length of strand produced, register plate and tube box for heating by steam or gas. One attendant.

Horizontal hemp rope closing machine capable of making three strand ropes up to 5 inches circumference. Complete with apparatus for altering the twist whilst running, for making hard or soft rope and appliances for indicating the length of rope made, change wheels, 8 strand bobbins and a coiling reel to take off the finished rope. One attendant.

Shafting, driving gear, etc. The plant is complete with bright steel shafting, bearings, brackets, and pulleys for belt or rope, striking gear, &c.

The engine is of the horizontal type of 12 nominal horse power. The boiler is of the multitubular construction and is complete with all furnace, steam and feed water fittings and connections.

The value of this plant is £1399 0 0
and the cost of packing for shipment and delivery f.o.b. is about 6 per cent.

The engine and boiler are of greater power than is required for driving the abovenamed machinery but provision is made for extensions and the buildings are arranged for these to be made without interfering with existing operations.

Tarring machine. The tank is lined with copper and heated by steam for treating eight rope yarns singly or collectively, complete with winding machine carrying eight spindles, and bobbins which are suitable for use on the rope making machine.

The price of the machine is £140 0 0 and is given separately because many factories do not produce tarred rope.

The plant is conveniently arranged in ground floor buildings (from designs furnished by the writer) which, including an open yard occupy an area of about 100 yards square.

The fibre passes from the store and hackling room into the spinning room and thence to the stranding and closing machine room.

The tarring room adjoins that last-named and both communicate with the finished store which is alongside the offices.

The engine and boiler are in separate buildings and the arrangement throughout insures economy in labour and facility for supervision.

TWINE MAKING.—The information required for preparing estimates for plant for this purpose are :—

The kind of fibre to be used if possible with specimens.

Specimens or details of the sizes and kinds of twine required.

The sizes, weight and shape of balls, &c. to be made up.

The quantity required in a given time.

TEA PREPARING MACHINERY.

TEA PREPARING.—The first process after plucking the green leaf, partakes more of a chemical than a mechanical nature, and is known by the term "withering," which is really "fermentation."

The old process is to spread the freshly gathered leaf on shelves made of jute hessian, placed closely one above another and leave it there for 18 hours, more or less according to the weather. The hessian is usually kept coiled on wooden rollers until required ; it is then unrolled and fastened in slots on upright posts, and various mechanical devices have been adopted for stretching the hessian, for rolling it up, for emptying the leaf off the sheets or shelves, and for increasing the rapidity of spreading and removal of the leaf.

For moist climates, and especially during the monsoon season, withering is a most troublesome process, because the leaf comes into the factory dripping wet, and, if only natural means are relied on, two or three days may be required to complete the wither.

Several mechanical appliances have been used to overcome this difficulty, and reduce the time required for the operation. to a certainty.

Centrifugal driers of the type Fig. 6081 may be adopted at comparatively low cost, as will be seen by reference to the price of these machines. The moisture is rapidly expelled by these machines, and the leaf is then spread out and subjected to a current of warmed air projected or induced ; this current, as is well known to planters, must be evenly distributed throughout the room.

Air propulsion.—This is sometimes effected by employing a fan of the type indicated in Fig. 3153 or 3154, Section 4, which is arranged to draw air, warmed by passing through tubes in the boiler flues, and distribute it in the withering rooms.

A suction fan is used in other cases, the action of which is described on the same page as that last referred to, with prices of both systems of fans, and advice on the use of any of these machines will be gladly given, on receipt of details giving the conditions to be fulfilled

Exhaust blast from the tea drying machine, Fig. 6111, is also frequently used and, although the air, as it leaves the drier, is fairly charged with moisture, it is undoubtedly effectual in accelerating the withering process although on theoretical grounds, such would not be expected.

When the green leaf assumes the soft and silky texture which is the indication that the wither has been completed, it is removed in baskets or boxes to the rolling machine.

ROLLING MACHINES.—The ancient practice of hand rolling still largely followed in China, Japan and some other tea producing countries, is entirely superseded, on almost all British estates, by machinery of the type illustrated in the engraving. Fig. 6110 (Brown's patent).

Without going into minute details of mechanical construction it may suffice to say that the principle on which the successful tea rolling machine is based, is that of placing the tea in a box which is moved backward and forward by a crank and connecting rod, the bottom of the box having a similar motion but at right angles with that first named. These combined motions produce a circular or rolling effect on the tea which is held down in the box by a heavy lid, or by a lever with appliances for regulating the pressure on the leaf. In the machine illustrated, the lid also receives a circular movement and this increases the speed of working and lessens the chance of heating.

The machine takes a charge of 300 lbs. and with this large charge, which exceeds the capacity of any other machine, the "roll" is completed without heating.

The power required is about 2½ H.P. and the price of the machine is .. £135 0 0

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

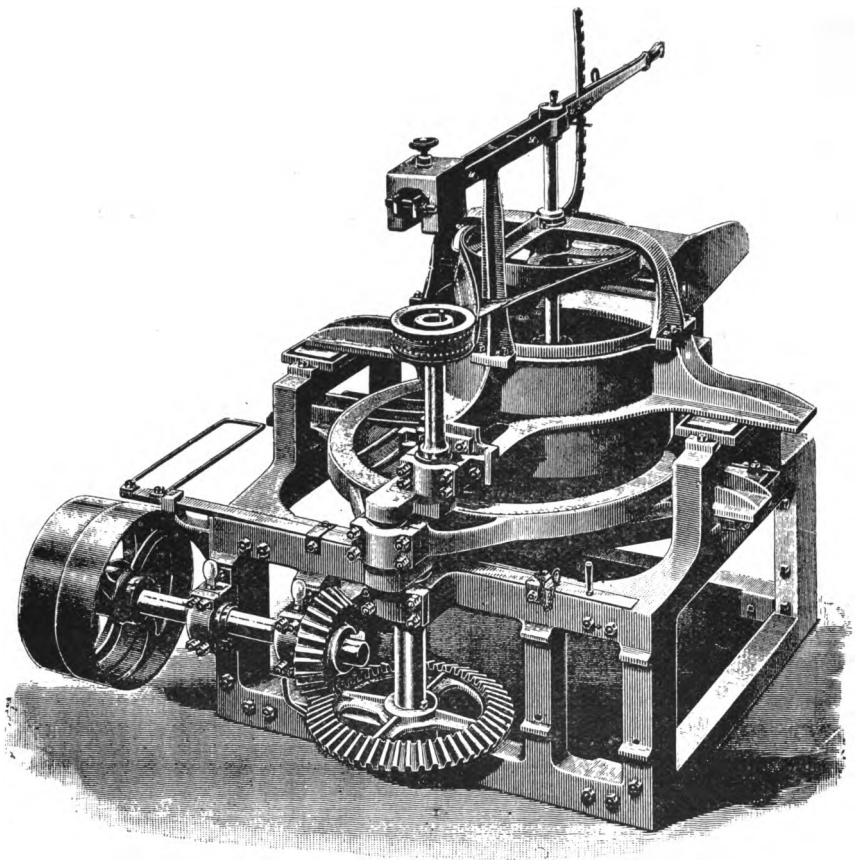


Fig. 6110.

TEA DRYING or "firing."—The machine Fig. 6111 (Brown's patent) is used for dessicating many kinds of fruit and other products but the present remarks apply exclusively to tea firing.

The furnace in which the heated air is generated is shown alongside the drying chambers, but to avoid heat, carrying fuel, &c. in the factory, the furnace can be outside or in any convenient position. The hot air is drawn from the furnace by an exhaust fan and is passed alternately over and under the trays on which the leaf is placed in the drying chamber. The result of this is that the leaf is completely and automatically submitted to the current of heated air in its passage through the chamber, without manual labour and—with ordinary care—over-firing is impossible.

The experience gained in the use of large numbers of the dessicators indicates that the consumption of fuel is usually less than $\frac{3}{4}$ lbs. of dry wood for each pound of tea made.

It is a common practice, as mentioned in the preceding remarks, to pass the blast into the withering loft after it has served its purpose in the firing chamber, and to use the machine for this purpose when tea is not being fired.

The output given in the following tables is, in each case, the average obtained under widely varying conditions of manufacture and of atmosphere.

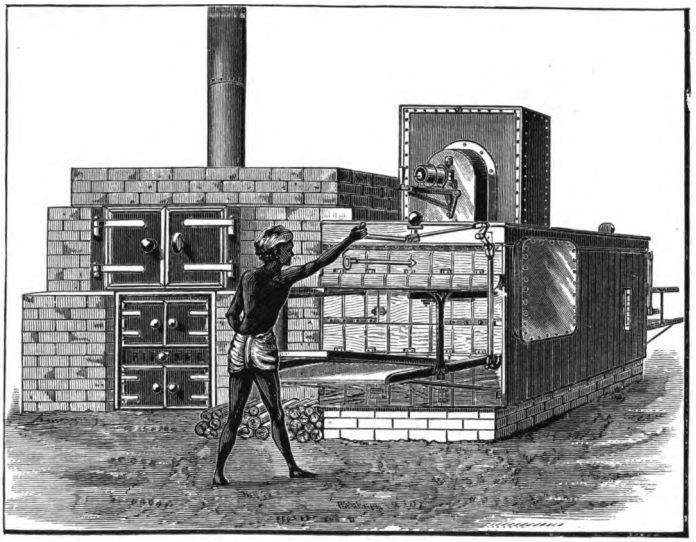


Fig. 6111.

PRICES OF TEA FIRING MACHINES, Fig. 6111.

Capacity of machine .. .. lbs. per hour	80	120
Price of machine complete with teak cover	£105	£145
Approximate measurement .. .. cubic feet	300	380

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

MACHINES FOR DESSICATING FRUIT, COPRA, &c., are similar in construction and arrangement to that illustrated by Fig. 6111. Fruits and the numerous products which are successfully treated by these machines, vary so widely in their composition that reliable data, with regard to output, cannot be given but whatever it may be, the ratios will closely resemble those indicated in the foregoing table.

The prices for the machines for dessicating fruit, complete with furnace and teak casing or the drying chamber are the same as for tea firing.

CORN MILLING MACHINERY.

As in oil milling (referred to later on) the comparatively modern process of roller milling has to a large extent superseded the ancient system of millstone grinding (see Fig. 6120) and, for the production of fine flour on a commercial scale, will undoubtedly continue to do so.

ROLLER MILLING is based on the principles of gradual reduction, complete purification and fine separation.

These processes are carried out very perfectly by the undernamed machines– all on Turner's system, which is so largely and successfully used in this and other countries—and which enable the miller to obtain the purest and most diversified products.

The sequence of operation is as follows :—

The breaking process by roller mills of the type Fig. 6115, with grooved rollers.

The sifting process by reels or sieves, illustrated by Fig. 6116 and 6117, which classify the products according to size.

The purifying process by sieves and currents of air which eliminate deleterious matter not separable by sifting alone, see Fig. 6118.

Reduction into flour of the purified semolina or middlings, in mills similar to those illustrated by Fig. 6115, but with perfectly smooth rollers.

Final dressing in the centrifugal machine, see Fig. 6119.

The prices of some sizes of the machines will be found in the following tables and those of other sizes will be sent on demand.

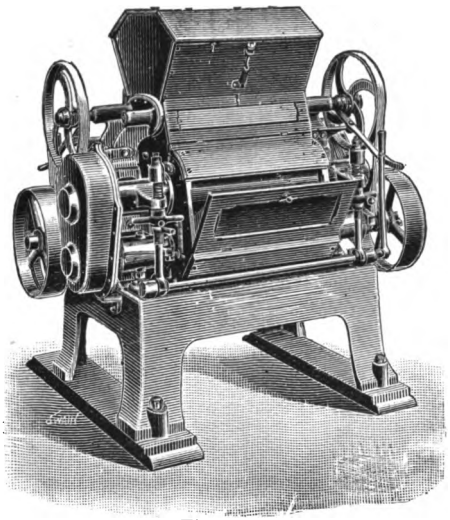


Fig. 6115.

BREAK ROLLS.—Fig. 6115 represents a mill with four pairs of chilled iron rolls, grooved from about 8 or 10 cuts to the inch in the first, to 22 or 24 in the last break, and the appliances for driving them at the requisite different speeds. To produce the largest possible quantity of semolina or middlings, it is essential that the rolls should be very accurately grooved.

The wheat having been properly cleaned—as a preliminary to the break process—is fed in at the hopper and is opened in its passage down, between the rolls which, as above indicated, run at different speeds, the spaces between them being adjusted by screws and levers.

The grain is usually passed through four pairs of break rolls, the products from the first three pairs being sent in one direction, whilst the residue from the fourth pair becomes bran.

Some of the sizes in which these machines are made, the prices of them and of spare rolls will be found in the following tables.

PRICES OF FOUR ROLL MILLS, Fig. 6115.

Diameter of rolls .. .. .. in.	6	8	8	9
Length of rolls .. .. .. in.	12	15	18	20
Price with fluted rolls	£60	£83	£88	£102
,, ,, smooth rolls	£55	£77	£82	£96
Approximate measurement .. cub. ft.	52	69	80	105
Spare fluted rolls .. .. per pair	£7 11	£12 10	£14 11	£17 10
,, plain rolls .. .. ,,	£6 5	£10	£12 2	£14 10

PRICES OF THREE HIGH ROLL MILLS.

Diameter of rolls .. .. .. in.	6	8	9	9
Length of rolls .. .. .. in.	10	15	20	25
Price with fluted rolls	£40	£67	£78	£85
,, ,, smooth rolls	£38	£63	£73	£78
Approximate measurement .. cub. ft.	28	62	86	91
Spare fluted roll	£3 2	£6 5	£8 15	£10 10
,, plain roll	£2 10	£5	£7 5	£8 10

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

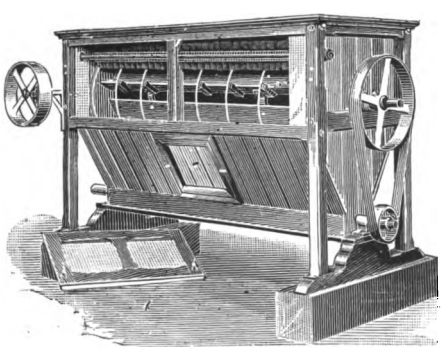


Fig. 6116.

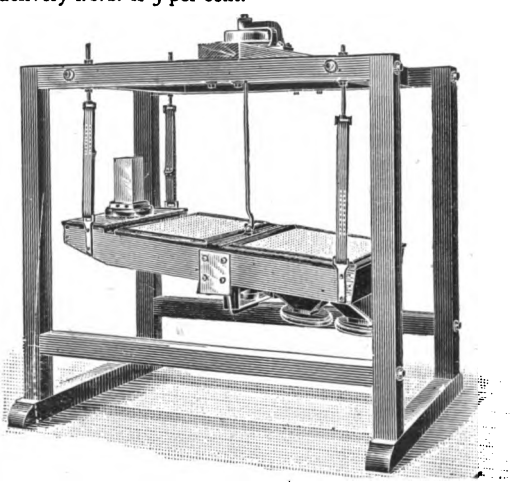


Fig. 6117.

SCALPERS OR SIFTERS represented by 6116 and 6117 come between each pair of break rolls and separate the semolina and flour from the broken wheat.

The scalper, Fig. 6116 has a hexagonal reel provided with internal buckets which cause the material under treatment to be distributed over the largest possible area of the silk screen, and this is constantly cleaned by a brush which maintains efficiency in continuous work.

The vibromotor scalper and sifter, Fig. 6117. An ingeniously arranged vibratory motion is imparted to the sieve and these machines are rapidly supplanting the scalpers, Fig. 6116.

The prices are exclusive of silk covers.

PRICES OF INTER-ELEVATOR SCALPERS AND REELS, Fig. 6116.

Dimensions of reels ..	in.	39 by 16	59 by 16	59 by 24	78 by 24	78 by 32
Price with single worm	..	£10 10	£12	£16 15	£19 10	£26 10
,, ,, double ,,	..	£12 15	£15	£19 15	£23	£30 10
Cross gears—extra ..	..	£1 15	£1 15	£2 10	£2 10	£3

PRICES OF VIBROMOTOR SCALPERS AND SIFTERS, Fig. 6117.

Dimensions of sieves...	in.	36 by 24	42 by 24	48 by 24	48 by 30	48 by 36
Price with one sieve ...	...	£16	£18	£20	£27	£35
,, ,, two ,, ...	...	£20	£22	£24 10	£33	£42
Extra for central division	...	£1 5	£1 5	£1 10	£2	£2 5

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

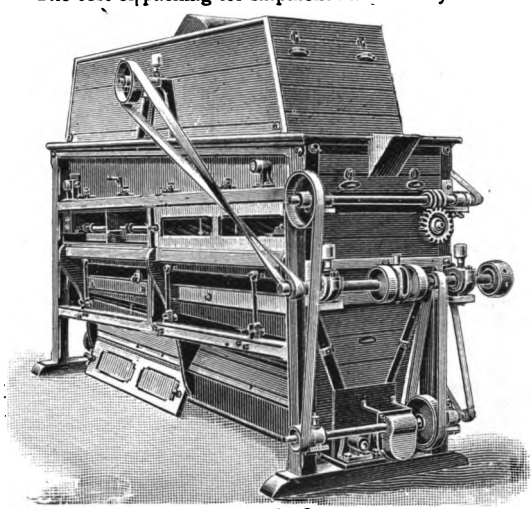


Fig. 6118.

The purifier.—The process of purification follows the breaks and is much the most delicate and important part of the system of roller milling.

The stock to be purified comprises the outsiftings from the scalpers, and, to ensure the best results in the subsequent processes, this product has to be "dusted," *i.e.* all the flour taken away and graded in sizes before it reaches the purifier.

The purifier, Fig. 6118 may be described as an oblong box, inside which is a sieve covered with silk; an exhaust fan fixed on the top of the machine induces an inflow of air from below the sieve, which lifts all the branny particles and offal that is in the stock, and deposits it on trays above the sieve.

The heaviest material being the purest, falls on the sieve and passes through it; a hopper conducts it to the smooth rolls for further treatment.

The prices do not include silk covers.

PRICES OF "TURNER" PURIFIERS, Fig. 6118.

Dimensions of sieves ... ... inches	72 by 10	72 by 16	84 by 16
Price of single purifier	£50	£60	£70
,, double ,, ...	£85	£105	£125

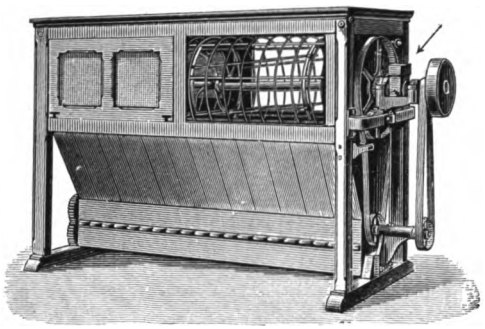


Fig. 6119.

Reduction into flour.—This is effected by passing the purified middlings through machines generally similar to Fig. 6115, but the rolls are quite plain, not grooved.

As in the purifiers, the stock is graded for purity and size, the better quality going to one set of rolls and the inferior quality to others.

The reduction into flour is not completed at one operation but is distributed over several pairs of rolls according to the capacity of the mill. As an example of this, for a 2 sack plant already referred to, and mentioned further on, there are usually four reductions, whereas in mills of larger capacity the number of reductions would be increased.

Centrifugal dressing machine.—As with the breaks, the material has to be dressed after each reduction. This is done in a machine of the type Fig. 6119, which consists of a rectangular case in which is an outside reel covered with silk and provided with beaters, inside the screwing reel. These revolve at a higher speed than the outside reel and beat the stuff through the silk.

From three to six of these machines—according to the perfection of products desired—will be required for a small mill, such as that last mentioned; the processes of rolling and dressing being continued until all the flour has been extracted and nothing but offal remains.

The following prices do not include silk covers.

PRICES OF CENTRIFUGALS, Fig. 6119.

Dimensions of reels .. inches	39 by 16	59 by 16	78 by 16	59 by 24	78 by 24
Price with single worm ..	£15	£20	£25	£33	£38
,, ,, double ,, ...	£17 15	£23	£28 10	£36	£41 10
Measurement .. cubic feet	33	43	51	80	88

The cost or packing for shipment and delivery f.o.b. is 5 per cent.

What is termed "**patent flour**" is made from the purest middlings whilst that called "**straight run**" consists of all the flour in the grist mixed together.

ROLLER MILLING PLANT to produce two sacks (560 lbs. or about 255 kilog.) of high class finished flour per hour, with four reductions and six breaks would comprise :—

Two fluted four roller mills for breaks.

Three smooth four roller mills for reductions.

Three inter-elevator scalpers, with cross gear. If with two vibrometer sifters in lieu of these the extra cost is £12.

Three inter-elevator reels with cross gear.

Four centrifugals with double worms.

Two centrifugals with single worms.

One Turner dustless purifier. One sifter and one single leg purifier, dust collector, fan, five spout packers, covers for machines, elevators, worms, casing, &c.

Shafting, bearings, pulleys, driving belts, and accessory fittings.

The cost of this plant is £1235.

The measurement as delivered ready for shipment is about 1840 cubic feet or 46 tons measurement and the cost of packing for shipment and delivery f.o.b. is 5 per cent.

A WHEAT CLEANING PLANT for a two sack mill comprises :—

One zig-zag separator. One horizontal smutter. One horizontal brush machine. Three dust collectors. Elevators, worming and casing, shafting, belts and sundry accessories.

The cost of this plant is £275, and the cost of packing for shipment and delivery f.o.b. is 5 per cent.

ROLLER MILLING PLANT to produce one sack (280 lbs. or about 177 kilog. of high class finished products per hour, comprises :—

One fluted four roller mill for breaks.

One mill as above but with two fluted and two smooth rollers.

Two smooth four roller mills for reductions.

Two inter-elevator scalpers, with cross gear. If with two vibrometer sifters in lieu of these, the extra cost is £19 5 0.

Two inter-elevator reels.

One centrifugal, with double worms and four with single worms.

One Turner dustless purifier. One sifter for offal divider. Dust collector, fan, spout packer, covers for machines, elevators, worms, casing, &c. Shafting, bearings, pulleys, driving belts and accessory fittings.

The cost of this plant is £735. The measurement, as packed for shipment, is about 1480 cubic feet or 37 tons measurement.

WHEAT CLEANING AND STORING PLANT.—This consists of a horizontal smutter, a horizontal brush machine, two dust collectors, sack hoist, elevators, worms, spouting, shafting, pulleys, belts, &c., also four wheat mixers, complete with spindle, elevator, worms, spouting, pulleys, belts, &c.

The cost of this plant is £245. The measurement, as packed for shipment is about 1160 cubic feet or 29 tons measurement.

ENGINE, BOILER, &c.—The engine is horizontal, the boiler is of the Cornish type with Galloway tubes and is complete with feed apparatus, all furnace, steam, feed, and water fittings, steam and other pipe connections.

The cost of this portion of the plant is £260, and the measurement is about 410 cubic feet or 10½ tons measurement.

The cost of packing for shipment and delivery f.o.b. is 5 per cent in each case.

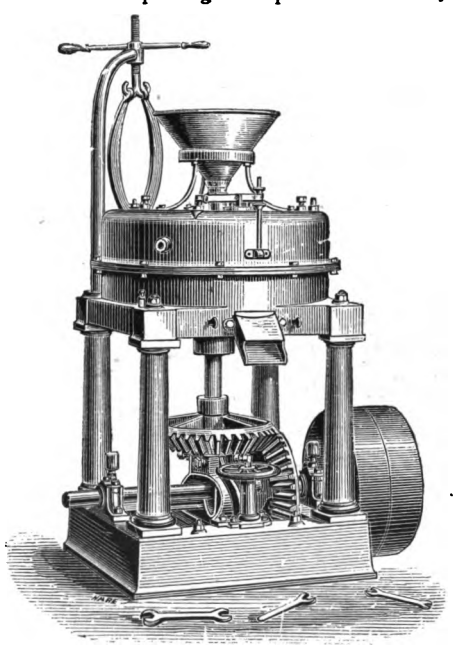


Fig. 6120.

CORN GRINDING MILLS.—Fig. 6120 illustrates the well-known type of mill for grinding wheat, maize, &c. into fine flour for domestic use, or coarse meal for cattle feeding and the output of each size of mill will be found in the following tables.

These mills are also used for many other purposes, such as grinding colours, spices, clay for fine earthenware, &c , and are sent out complete as shown, or ready for fixing on a timber frame provided by the purchaser ; this is usually made to drawings supplied with the machinery.

For maize grinding, a maize cracker over the stone case is a valuable addition ; this reduces the work to be done by the stones and increases the time they will run without re-dressing.

The vertical spindle has adjustable bearings for the toe step and neck, the bearings throughout are of hard gun metal.

The horizontal shaft may be driven by geared wheel, or by pulleys and belt as indicated in the engraving.

The prices will be found in the following table of mills with grey stones (required in rice milling) and of other combinations. also of stone crane for lifting the top stone for dressing, and other accessories.

The quantity of wheat or maize the mills are capable of treating per hour is given in the following tables in bushels, and the quantity of fine flour produced is easily ascertained if it be remembered that the average yield from a bushel of wheat (weighing 60 lbs.) is 35 to 40 lbs. of fine flour.

The output from the respective sizes of mills of 2, 3 or 4 pairs of stones, as well as the prices and the driving power required, are multiples of the figures given in the subjoined table for single mills, so that estimates for mills of any desired capacity will be made by merely multiplying these figures.

PRICES OF CORN GRINDING MILLS, Fig. 6120.

Diameter of stones .. .. inches	36	42	48	54
Driving power required .. .. .. H.P.	3	3½	4	5
Revolutions, horizontal shaft .. .. per minute	150	135	120	110
Fine meal ground per hour .. .. ..bushels	3½	4	5	6
Coarse ,, ,, ,, ... ,,	7	8	10	12
Price of mill with French stones	£61 10	£72	£87	£108 5
,, ,, ,, grey bed stone and French runners	£56 10	£67	£80	£98
,, ,, ,, both grey stones	£51 10	£62	£72	£87
Approximate measurement .. .. .. tons	4	5	7	8½
Price of mill without stones	£44	£52	£58	£68
,, complete to fix on table	£56 10	£66	£77	£99
,, crane for lifting upper stone	£6	£6 10	£7	£8 10
,, maize cracker	£6 10	£6 10	£8 10	£8 10

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

DRESSING TOOLS.—An outfit of tools for dressing the millstones consists of 6 best cast steel mill bills and two handles, stone staff and a metal prover in case, and the cost of these for **mills up to 30 inches diameter** is £5 0 0
For mills exceeding 30 inches diameter, the price is £6 0 0

UNDER RUNNER GRINDING MILLS similar in arrangement to those last referred to are largely used in the Colonies and elsewhere for grinding fine and coarse meal, also for grinding white lead and other materials in a liquid state.

The stones are easily turned over for dressing and the mills with stones 15 inches diameter are made to work by hand power at an extra cost of £3.

The appliances for sifting maize after it has been ground, consist of a sifting tray suspended below the delivery spout and driven from a lay shaft.

Dressing Machines for producing fine flour, see Fig. 6116.

PRICES OF UNDER RUNNER GRINDING MILLS.

Diameter of stones .. .. inches	15	20	24	30
Driving power required .. .. .. H.P.	1½	1½	2	3
Revolutions of horizontal shaft per minute	120	280	240	180
Fine meal ground per hour (about) .. ..bushels	1½	2	2½	3
Coarse ,, ,, ,, ... ,,	4	4½	5½	7
Price of mill with French stones	£19	£27	£33	£41
,, maize sifter	..	£3	£3 10	£4
Approx measurement .. .. .. cubic feet	23	24	36	58

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

Engines, Boilers, Turbines, &c., see Section 1.
Shafting, Pulleys, Belts, &c., see Section 4.

PRESSING AND BALING MACHINERY.

HYDRAULIC PRESSES.—The high pressures which all hydraulic machines have to sustain and (in hydraulic pressing) the constant recurrence of operations, each involving pressures varying from 2,500 to 10,000 lbs. per square inch—and sometimes more—render it imperative that excellence of materials and great precision in design, construction, and workmanship should be the first consideration, for inaccuracies almost inevitably lead to results which, although unattended by danger, are frequently vexatious enough.

If it be understood that these conditions have been carefully considered and studied in the presses for various purposes, referred to in the following pages, repetition with regard to details of construction will be unnecessary ; these will be (generally) as follows :—

Cylinders and Rams.—For presses with rams not exceeding 6 to 8 in. diameter and working at pressures not exceeding 4,000 to 5,000 lbs. per square inch, properly selected cast iron answers every purpose. If, however, the transport of heavy pieces is expensive, the Writer has found that a saving in the total cost—including land carriage—has been effected by making both cylinder and ram in cast steel.

Cylinders of large dimensions or for sustaining high pressures should always be made in steel of special quality or—as the Writer has sometimes found necessary—in forged cast steel.

The Press Columns are made of selected scrap iron or mild steel forgings and are usually finished bright for the purpose of detecting flaws which might not be visible in the forged state. The ends are accurately turned to dead lengths, and the press head and base are faced to ensure uniform bearing at top and bottom, for the collars and nuts.

The Pressure Pumps.—Whatever may be the design, the pumps are made of hard gun metal, phosphor bronze or magnolia metal for moderate dimensions and pressures. When certain limits are exceeded, the pumps are made of steel forgings—in some cases oil tempered to increase their strength and durability—and the plungers are made of one or other of the above named metals, or of steel coated with those metals.

MULTIPLE CYLINDER BALING PRESSES.—The system now referred to (Cummin's patent) may be described as a "step by step" process, whereby finished bales weighing 400 and 500 lbs. are turned out at the rate of 15 to 20 per hour, compressed respectively into 6 ft. 4 ins. and 8 ft. cubical measurements.

For this purpose three boxes are used, each with its own cylinder and ram ; all work at a uniform pressure of about 2½ tons per square inch, and they are varied in diameter to give the area requisite for the different degrees of compression.

A steel bale box revolves around the base plate and appliances are provided for locking it over the respective boxes, so that the cotton (or other fibre) which has been placed in the small ram box, is charged into the baling chamber. The revolving box is then moved over the next ram, and so on until the finishing ram has put on the final pressure and the bale has been hooped, ready for delivery. By that time another bale is ready to take its place and the work is continued in the sequence above indicated

Each press is complete with cast iron follower and lashing plate, automatic safety valve, pressure and return water pipes and all accessories required for efficient working.

PRICES OF MULTIPLE CYLINDER PRESSES.

Weight of bales .. .. lbs.	300	400	500
Capacity, bales per hour	18	20	20
Price of press—compound rams	£650	£2315	£2500
,, ,, ordinary ,, ...	£600	£2165	£2350
,, hydraulic pumps	£320	£625	£625
,, engine and boiler	£475	£600	£610

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

BALING JUTE, HEMP, &c.—Any of the presses last referred to are easily adapted for pressing jute, hemp, coir and other fibres and, if desired, certain additions can be made whereby half-pressing and finishing can be carried on simultaneously, increasing the output to about 40 bales per hour.

THREE BOX PRESSES.—A modified arrangement of the press, type Fig. 6127 admits of the use of three boxes which revolve on a strong column.

By this system the operation of filling, pressing and hooping can be carried on without intermission, turning out a large number of bales with a minimum cost for labour and supervision.

HYDRAULIC PRESSES FOR BALING REFRACTORY MATERIALS.—The Author has given much attention to this branch of construction, and thinks that the following information with regard to a plant he designed and constructed, some years ago, may be useful.

The presses were originally designed for a working pressure of 4 tons to the square inch, but this has subsequently been increased to 5 tons, and the results obtained have been so satisfactory that the presses, since put down, are identical in proportion and construction with those first sent out.

The presses are of the type indicated in **Fig. 6127** with ram of cast steel, 15 in. diameter and 4 ft. stroke; the cylinder is also of cast steel and is fitted with special hydraulic leather packings. The rising table is 3 ft. by 1 ft. 10 in. and the press boxes are 5 ft. high. These are constructed of steel plates of much greater section than are used for the press Fig. 6127, and the steel strengthening bands, hinges and fastenings, more massive. Each press has two boxes mounted on steel undercarriages with double flanged wheels, rails, &c., this admits of a bale being pressed as soon as that which has been made is removed for hooping.

The pressure is supplied by a set of four hydraulic pumps, two rams of 2 in. and two of 1½ in. diameter, with automatic lifting valves and three-way cock to presses.

To withstand the high working pressure of 4 (now 5) tons per square inch, the pumps are forged in best tool steel bored out of the solid and oil tempered to increase their strength, and the rams are of special quality of phosphor bronze. The speed is reduced by cast steel intermediate gear and the crank shaft is of mild steel; the bearings in the side frames and the heads of the connecting rods, are of magnolia metal having ample surfaces.

The engine is horizontal with cylinder 10 inches diameter, the boiler is of the Cornish type and the chimney is of wrought iron partially lined with fire-brick.

In addition to the usual supply of spare parts, packings, &c. as there were no facilities for having repairs executed locally or within a reasonable time, a small equipment of engineers' tools, stores, &c. were sent out, of the total value of about £300.

These comprise a smith's hearth, anvil and tools. A screw cutting lathe, drilling machine, small screwing machine for pipes and bolts, grindstone, shafting, pulleys, &c.; also an outfit of mechanics' tools and engineers' stores. These were found invaluable when the buildings and machinery were in course of erection and, since then, for the small repairs and renewals incidental to all machines in constant work.

The presshouse and warehouses for the pressing plant and for storage of materials, as originally designed consist of two spans each of 36 ft. and a length of 100 ft. The boiler-house, engine and pump room adjoin the above named buildings, and the roof principals are of wrought iron, supported by wrought iron columns of H section with cast iron bases. The roof and sides are of corrugated galvanised iron and the buildings are complete with eaves, down spouts, doors, wrought iron windows, &c.; the same construction has been retained for the large extensions subsequently made.

Other pressing installations have been put down in which three, four and six pumps complete with engine have been used and—in some cases with accumulators, as described in the article on oil mill machinery.

Purchasers requiring machinery for special purposes, involving exceptional pressures, should state the working pressure required, or samples of the materials to be baled should be supplied, the weight of bales to be produced and the dimensions of the rising table and boxes or the weight and dimensions of the bales.

HYDRAULIC BALING PRESSES.—**Fig. 6127** represents a plant, of which large numbers have been made, for baling cotton, esparto and other fibres and materials, each press equal to turning out 6 or 8, or more finished bales of cotton per hour, of various weights, but usually about 5½ cwt., and not exceeding 25 ft. cubic measurement.

Each press is provided with two pairs of rails and two boxes mounted on steel under-carriages with flanged wheels, so that they are easily run out and a box filled, ready for pressing, whilst the bale just made is being hooped.

The plant now referred to works continuously during the **ginning** season and the pumps are driven by steam power. At other times the presses are employed at tarif rates, per bale or per hour. Steam power is not then required and (for this reason) the pumps are made to work by steam or entirely by manual power, either through the accumulator or direct to the presses.

The press has a massive bed plate, and the entablature is supported on four forged steel columns with solid collars turned to dead lengths and secured by forged steel nuts. The dimensions of the rising table are 4ft. by 2 ft. 6 in., the ram is turned to 9 in. diameter and has a rise of 6 ft.

The cylinder is made of tough close grained cylinder metal and is bored and fitted with cupped leather hydraulic packing, the whole being tested to double the working pressure.

The two press boxes, constructed entirely of steel, are 8 ft. high and the internal dimensions are 4 ft. by 2 ft. 6 ins. The sides of the boxes are made of rolled steel plates planed on all edges, strengthened at intervals by cast steel bands with hinges and the improved form of fastening shown in the engraving. The under carriage for each box is made of steel and has four flanged wheels.

The Accumulator.—The cylinder is fixed to a massive base plate and is equal to supplying two presses. The ram has a strong cross head from which the weight table is suspended; this (as in many other instances) was loaded with masonry, which with the timber guides were provided by the purchaser.

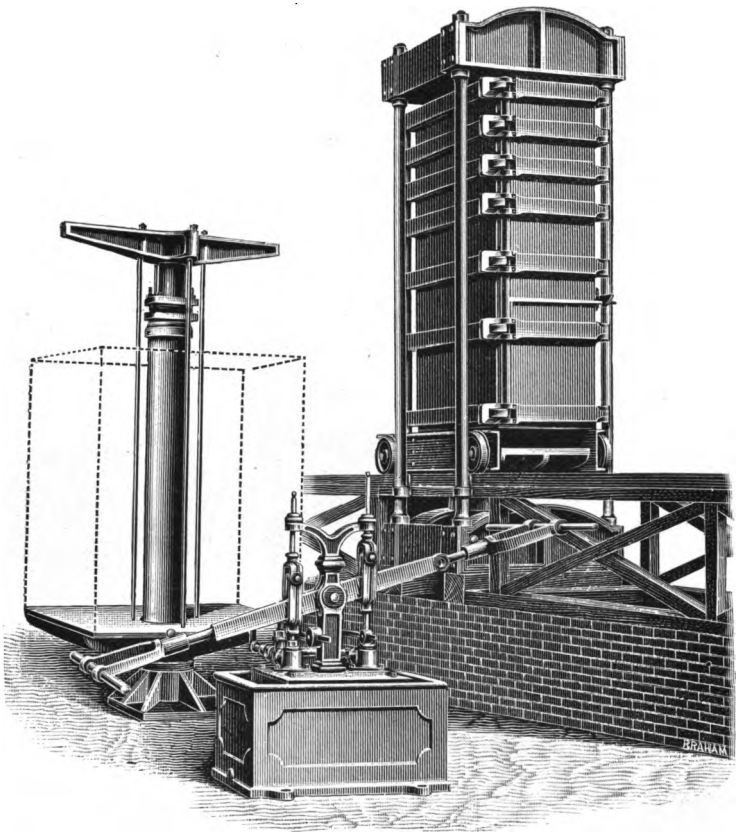


Fig. 6127.

The hydraulic pumps.—For the reason above indicated, these were arranged to be driven by power, or by double lever handles worked by 4, 6 or 8 men (according to the speed of working required) and to pass the pressure through the accumulator or direct to the presses, as desired. The pumps are made of hard gun metal and the rams are 2 ins. and 1 in. diameter with valve which opens automatically as soon as the pressure exceeds that to which it has been set.

The following prices for one and two press plants include the hydraulic main pipes, connections, valves, &c. required in each case.

PRICES OF BALING PRESS PLANT, Fig. 6127.

	1	2
Number of presses		
Price of plant without accumulator	£370	£700
,, ,, with ,, ...	£565	£985

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

The cost of steam engine, boiler and shafting suitable for driving the pressing machinery is about £70.

Do. gas or oil engine £85 to £100.

BALING PRESS WITH WOOD BOX to exert any pressure from 70 to about 700 tons and with any dimensions of table, clear height, or stroke of ram.

The arrangement is similar to that shown in Fig. 6127 but the boxes are made of well seasoned oak, or of teak and provided with strengthening bands and fastenings which, as usually fitted, are opened simultaneously by a lever motion. For heavy pressures the boxes are made of two planks, the inner boards running vertically and the outer ones horizontally.

The box has an extra false bottom, so that when a bale has been pressed and is being hooped the box can be refilled ready for another operation.

The presses are made specially and estimates will be furnished on receipt of information giving the conditions to be fulfilled.

BALING PRESS WITH GUIDE BARS.—This is similar to that last described but the baling box is rarely supplied; grooved baling boards in addition to the bars, are however frequently fitted.

PEAT BALING PRESS and for baling other materials such as rags, fibre, wood, wool, &c.

These presses (as the others just referred to) are made of any dimensions desired, but those in general use when working at a pressure of 2½ tons per square inch, have the proportions requisite for compressing peat weighing 1½ cwt. (about 75 kilog) into a bale measuring 3 ft. 6in. by 1 ft. 6 in. by 1 ft. 6 in.

The price of the press complete with box and fastenings is £75.

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

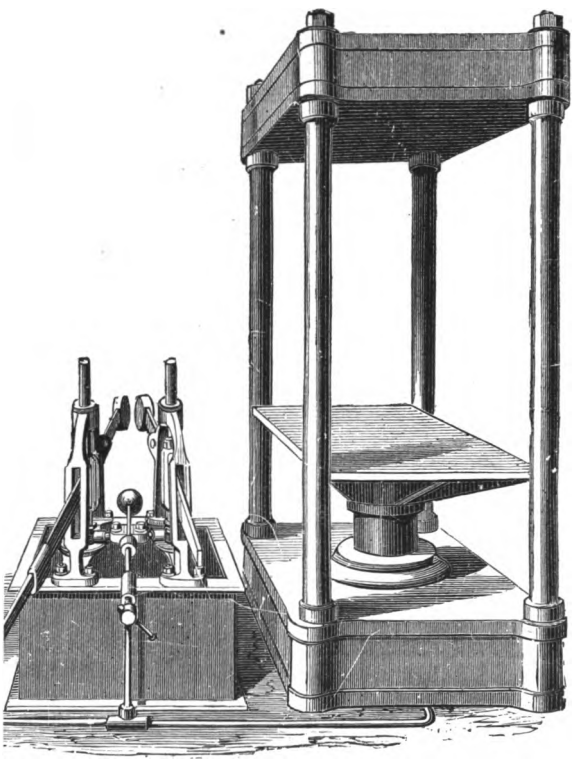


Fig. 6128.

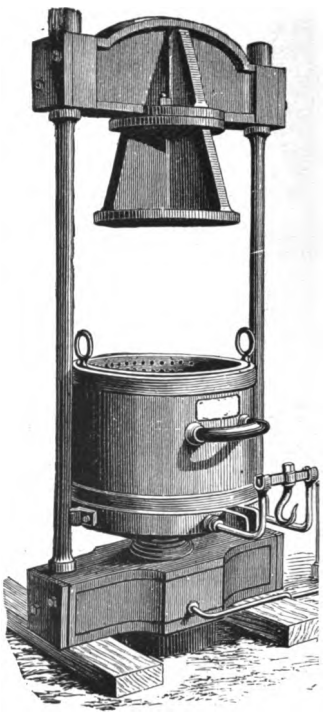


Fig. 6129.

Fig. 6130.

HYDRAULIC PRESS.—Fig. 6129 illustrates a form of press which is constructed with ram of any diameter or length of stroke, any size of table, and with pumps attached to the press, or separate from it as shown, or to be worked from an accumulator.

Amongst the purposes for which they are used may be mentioned—packing cotton, wool, hemp, straw and other fibres, hides, cloth, rags, &c., extracting oil from seeds, olives, stearine, &c; for pressing paper, printed matter and innumerable other substances, so that the range of conditions they fulfil vary as widely as the proportions in which they are made.

The sizes given in the following tables are those commonly required but other proportions are made at corresponding increased or reduced cost.

PRICES OF HYDRAULIC PRESSES, TYPE Fig. 6129.

Power of press ..	tons	30	45	70	70	70	70	70
Diameter of ram ..	ins.	4	5	6	6	6	6	6
Dimensions of table ..	,,	42 by 20	42 by 24	24 by 24	42 by 24	44 by 34	54 by 36	78 by 39
Rise of table	,,	36	27	15	27	48	42	42
Clear height above table	,,	60	60	36	60	60	84	84
Price of press	..	£33	£46	£44	£63	£72	£75	£80
Approximate weight ..	tons	1½	1¾	1¾	2½	3½	3½	4½

Power of press.. ..	tons	120	120	155	200	200	280	380
Diameter of ram ..	ins.	8	8	9	10	10	12	14
Dimensions of table ..	,,	48 by 30	54 by 30	36 by 24	42 by 32	48 by 32	42 by 36	42 by 36
Rise of table	,,	36	42	69	60	60	66	48
Clear height above table	,,	72	78	100	108	108	120	102
Price of press	..	£83	£95	£104	£108	£119	£170	£218
Approximate weight ..	tons	3½	3¾	4½	5	5½	7¾	9½

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

THE HYDRAULIC PUMPS, Fig. 6128, are suitable for working any of the undernamed presses and the prices with rams 1 in. and 2 in. diameter is ... ... £45 0 0.
See also Figs. 6132 to 6135 and prices.

HYDRAULIC OIL, HOP or DRUG PRESS.—Fig. 6130 represents a type of press which, with certain modifications, is useful for many purposes where only a moderate pressure is required.

For accelerating the work in hop pressing, two run out boxes are provided with rails on which they travel, so that a box may be charged and ready for the press as soon as that from which the wort has been extracted is removed.

Fruit Presses, Wine and Cider Filters, &c. see page 96.

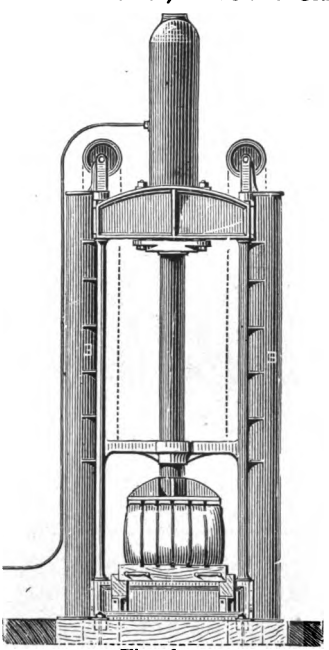


Fig. 6131.

HYDRAULIC BALING PRESS WITH INVERTED CYLINDER—The construction indicated in Fig. 6131 has been adopted for use in warehouses, upper floors, &c., where the foundations and depth below floor level required for presses of the ordinary construction, and referred to elsewhere, cannot conveniently be provided.

To suit these conditions the press cylinder is carried on a strong entablature which is connected to the top of a pair of hollow press columns of large diameter. These contain the counterweight requisite to raise the ram automatically after a bale has been made and the pressure shut off.

The counterweight is suspended by the chains passing over the pulleys at the head of the columns, the other ends being attached to the platen

The top plate is guided by carefully machined facing pieces attached to the columns ; these are fixed on a massive iron base plate, so that no strain comes on the floors excepting that due to the weight of the press.

The dimensions given in the list are those which are found generally useful, but presses of any other proportions are made at correspondingly lower or higher cost.

These presses render excellent service in baling or trussing yarns, skins, blankets, linen, cotton and woollen goods and for general use by shippers and exporters.

For Hydraulic Pumps see Figs. 6132 to 6135, and prices.

PRICES OF BALING PRESSES, Fig. 6131.

Power of press .. .. .. tons	20	30	45	75	120
Diameter of ram .. .. .. inches	4	5	6	8	10
Traverse of do. .. .. .. ,,	36	42	42	42	42
Dimensions of top plate .. .. ,,	48 by 30	60 by 36	84 by 51	42 by 33	42 by 45
Clear height to platen .. .. ,,	72	78	78	78	78
Price of press	£40	£55	£105	£118	£150
Approximate weight .. .. tons	1¾	2½	6	6½	8½

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

BALING TOOLS.—These vary considerably in quantity and kind and equally so in quality but a complete set of the best tools for roping and hooping bales costs about £11 and comprises:—

Anchor for roping, chisel for cutting hoops to length, rivetting hammer, shears for cutting hoops, paddle for rivetting, clamps to hold hoops whilst being rivetted, dogs to tighten hoops on bale, cutting tool for opening, two hole lever punch, one hole punch, lever for turning the tightening roller, and reversible tightening lever.

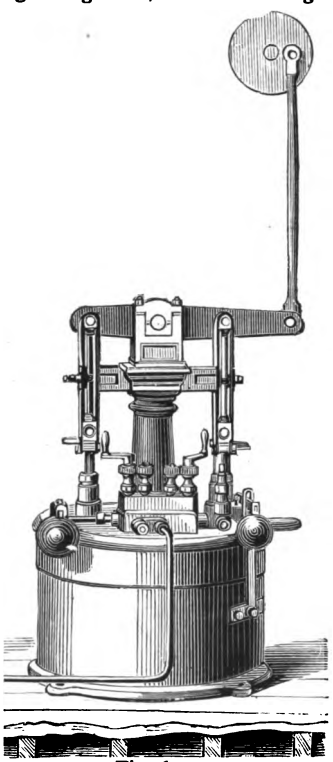


Fig. 6132.

HYDRAULIC PRESS PUMPS of the type Fig. 6132 as well as those subsequently referred to are made as specified in the remarks on "Hydraulic Presses."

The driving power is transmitted from an eccentric on an overhead shaft, to the connecting rod shown in the engraving and the pumps are made with one barrel respectively for low and high pressure, with two low and two high pressure barrels or with four barrels of equal diameters.

The large pumps run up the ram quickly and automatically cease to work when a determined pressure has been reached; the small pumps continue the operation and put on the final pressure which is usually equal to about 2½ tons per square inch of area, the whole operation occupying about 1 minute or less.

The following table gives the cost of pumps suitable for a series of presses for extracting oil, baling, &c., and the sizes and combinations are as follows:—

The pumps for presses with rams 8 in. diameter have one ram 2½ in. diameter and 7 in. stroke and one 1 in. diameter and 5 in. stroke.

For 12 in. rams, there are two rams of 2½ and two of 1 in. diameter and all have 7 in. stroke.

For 14 in. rams there are two rams 3 in. and two of 1¼ in. diameter and all have 7 in. stroke.

PRICES OF HYDRAULIC PRESS PUMPS, Fig. 6132.

Number of presses supplied	2	3	4	6	8
Price of pump for press with ram 8 in. diam.	£100	£105	..	..	..
Ditto ditto ditto with ram 12 in. diam.	..	£165	£170	£185	£190
Ditto ditto ditto with ram 14 in. diam.	..	£175	£180	£193	£200

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

HYDRAULIC PRESS AND PUMPS combined. The press is of the type Fig. 6129 but the pump is enclosed in a cistern which is attached to the base of the press.

The pump is worked by a lever and the presses are used for making up small bales, pressing extracts from drugs and other products.

At a moderate extra cost the press can be fitted for permanent or occasional use with boxes similar to those seen in the engraving Fig. 6139 for testing seeds to ascertain the quantity of oil they contain, for extracting essences, &c.

The undernamed sizes are those in general use and the prices include hydraulic pump, lever for working it, pressure gauge and pipe connecting it with the ram cylinder.

PRICES OF PRESS AND PUMP COMBINED.

Dimensions of table .. .. inches	12 by 12	16 by 16
Clear height above table .. .. ,,	24	24
Rise of table .. .. ,,	15	15
Price of press and pump	£30	£35

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

HYDRAULIC PRESS PUMPS AND ACCUMULATORS.—When an accumulator is used (see Oil Mill plant) one set of pumps of the type Fig. 3075, Section IV., supplies pressure to a group of 3, 4, 6 or 8 presses and great convenience, as well as economy is obtained by having separate pumping engines to supply the high and low pressure accumulators. These are fixed wherever may be convenient and the pressure is conveyed by the hydraulic mains, with branches, valves, &c. to each press or other machine.

The Writer has re-modelled several installations which were originally arranged to work with pumps direct, but subsequent additions made it desirable to adopt the accumulator system, and in every case the results have been completely satisfactory.

In other cases the accumulator (see Fig. 3077 or Fig. 6127) has been charged by pumps of the type Fig. 3076 or 6133 and the approximate cost of plant may be ascertained by reference to the engravings mentioned and the prices of the respective machinery.

The last named pumps are also frequently used in connection with the presses direct, without the accumulator.

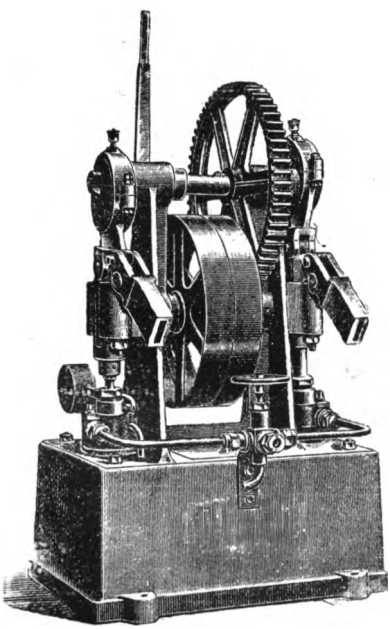


Fig. 6133.

HAND OR POWER PRESS PUMPS.—The compact and efficient arrangement shown by Fig. 6133 consists of a rectangular tank which carries the pumps and driving gear for working by power or by hand.

The pumps are 2 in. and 1 in. diameter with a stroke of 3 in.; the removal of a pin instantly detaches the pump for working by hand and both may be used simultaneously, if desired.

As will be seen, the pumps are complete with automatic relief valve, driving gear, fast and loose pulleys and handles.

The test pressure is 3 tons per square inch and the price of the pump is £60.

DOUBLE RAM PUMPS.—Another arrangement admits of the undernamed combinations:—

A to work with handle, price .. £50.
B to work by pulley .. .. .. £80.
C complete with steam engine, price £104.

Each pump is equal to a pressure of 2½ tons per square inch and is complete with accessories required for each combination.

DOUBLE RAM PUMPS of the type Fig. 6134 are made with rams of any proportions desired; those in general use are as follows:—

PRICES OF DOUBLE RAM PUMPS, Fig. 6134.

Diameters of rams	2 & 1 in.
Price of pumps	£45

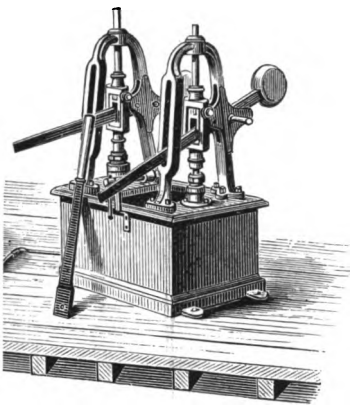


Fig. 6134.

Fig. 6135.

PRICES OF SINGLE RAM PUMPS, Fig. 6135.

Diameter of ram .. .. .. inches	1	1½	1¾
Price of pump	£12	£18	£23

HYDRAULIC STOP VALVES are made with one or more outlets, as enumerated, and are adapted to convey the pressure direct from the pumps to the ram cylinder, or from the accumulator.

In all cases the pipe nuts are chased for pipe of 1¼ in. diameter and the valves are made of tough gun metal or of best cast steel.

Recent improvements give complete control over the admission, the importance of which is well known to those accustomed to use hydraulic machinery working at high pressures.

PRICES OF HYDRAULIC STOP VALVES.

Number of outlets to presses	1	2	3	4
Price per set for working from pumps	£7	£14	£19	£23
Ditto ditto from accumulator ..	£14	£22	£25	£30

In all cases the cost of packing pumps, valves, &c. for shipment and delivery f.o.b. is 5 per cent.

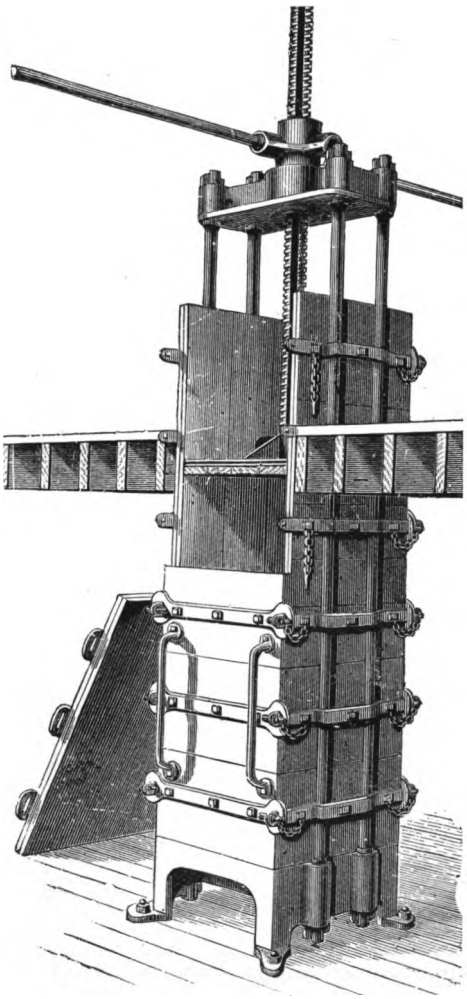


Fig. 6136

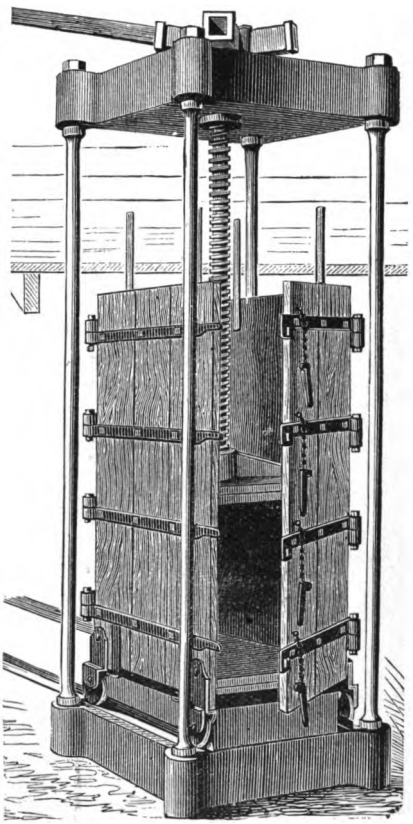


Fig. 6137.

SCREW BALING PRESSES of the types Fig. 6136 and 6137 often suffice for baling wool, cotton or other fibres at the station or plantation and for delivering them to market or at shipping port. In the latter case the bales are usually repacked and the bulk largely reduced in a hydraulic press similar to Figs. 6127, 6129 or multiple cylinder.

It is always desirable to fill the press boxes and work the screw from an upper floor as indicated in both engravings, but if this cannot be arranged the screw is worked from below; the cost of this modification is only a few pounds.

The press boxes are made of well seasoned hard wood or of steel plates; in both cases the sides are strengthened by the wrought iron or steel hinged or cottered bands seen in the engravings. If desired, the press Fig. 6137 is arranged for the bottom door to be hinged and lower to form an inclined plane for withdrawing the finished bale.

The screw is 4 in. diameter and has a square thread, accurately cut, and working in a gun metal nut which is fixed in the press head worked by four capstan bars.

The baling press, Fig. 6137, has a run out box with false bottom which carries the bale whilst it is being hooped setting the box free to be refilled, but a second box is frequently preferred and the price of this is given in the following table. Both presses are fitted with baling blocks on the platen and on the top plate.

PRICES OF SCREW BALING PRESSES, Figs. 6136 & 6137.

Height of box .. .. feet	5	6
Dimensions of box .. .. inches	48 by 24	48 by 24
Price of press, Fig. 6136	£45	£55
Ditto ditto Fig. 6137	£108	£120
Ditto of extra box	£33	£43
Ditto of steel box, each	£47	£60

The cost of packing for shipment and delivery f.o b. is 5 per cent.

HAY AND STRAW BALING PRESSES.—The question whether these should work vertically or horizontally is largely a matter of convenience, but the facilities for filling and discharging afforded by a well arranged portable press with a large horizontal box, are greatly in favour of this construction.

The press which fulfils these conditions consists of a strongly framed timber box about 5 ft. long and 3 ft. 6 in. wide and holds about 1 cwt. of hay; the filling door opens upwards leaving the box quite clear for filling from ground level or direct from the stack as may be most convenient. The discharging door is on one side, opening downwards and forming a slide for the bale when it has been secured by wire or cord.

The ram is rectangular and is projected forward by rack and pinion motion at each of the four corners of the ram. This arrangement maintains a uniform pressure on the bale and removes all tendency to jam. The forward motion is given by two men working a ratchet lever and, a bale of hay weighing about 1 cwt. is compressed to a measurement of about 3 ft. 6 in. by 1 ft. 6 in. by 1 ft. 8 in. or, varying with the kind of hay, a density of 12 to 15 lbs. per cubic foot.

The press is mounted on wheels with a swivelling fore carriage and, when filled direct from the stack, three men make and load up 4 or 5 tons per day.

The price of the press to be moved by manual power is £30.

Ditto ditto with shafts £32.

The cost of packing for shipment and delivery f.o b. is 5 per cent.

PORTABLE TRUSSING PRESS with or without travelling wheels, for trussing hay or straw into much less than half the bulk it occupies when loose. The press will truss about 3 tons of hay per day.

Price of press with travelling wheels	£16 10 0
Ditto without ditto	£14 0 0
If with weighing machine, extra	£5 0 0

OIL MILL PLANT.

OIL MILL PLANT.—Whether the old, or the Anglo-American system is adopted, or a combination of them, the sequence in the process involved in producing oil from various seeds, remains the same. These processes are sufficiently well known, but the following epitome of them and of the output to be expected from a given plant of machinery, the approximate cost of the plant and of the number of hands required to work it, may prove useful.

The first operation is to remove refuse matter from the seed by screening, then to pass it through a crushing mill (varied in construction to suit the kinds and quantities to be treated) and thirdly to convey it to the edge runner grinding mill in the old process, or direct from the crushing rolls in the Anglo-American process, but in both cases the seed has been ground and prepared for transmission to the steam jacketted heating kettle. Here it remains for a short time to liquify the oil which the seed contains and is then automatically discharged into bags or envelopes, ready for the hydraulic press where the oil is caused to exude and flow into channels around the sides of the press boxes, and thence to a receiving tank from which it is pumped to the large storage tank. In large mills the transmission of the oil producing materials from one process to the next, is entirely automatic.

Outline specifications of oil mill plant and descriptions of the machines in common use will be found further on but deviations from the arrangements therein contemplated must frequently be made, to completely adapt the machinery for the special treatment of certain classes of seeds or kernels, to suit existing buildings and so forth and, if the plant described does not seem to fulfil the desired conditions, information should be given on the following (amongst other) points:—

The kind of seed (or seeds) to be treated or, if possible, samples of them.

The weight or quantity to be dealt with in a given time—say 10 to 12 hours.

The dimensions of buildings, the power and positions of engines, boilers, shaftings, &c., if any of these are to be utilized.

In some cases the Anglo-American system which effects large economy in space, in the cost of labour and in production generally, will give the best result, whilst in others it is obtained by a combination of both systems and, with certain modification, the plant for working **Copra, Ground Nuts, Palm Kernels, &c.** is similar to that used for the treatment of ordinary seeds.

The output of a mill is necessarily influenced by the quality of seed, efficiency in management, &c., but the following data may be useful in determining, approximately, what output may be expected when different kinds of seeds are worked.

Taking 100 as the unit of weight for **Linseed** or **Rape seed**, that of other seeds will be :—
Cotton seed about 112. **Castor seed** about 70. **Cocoa-nut** about 122.

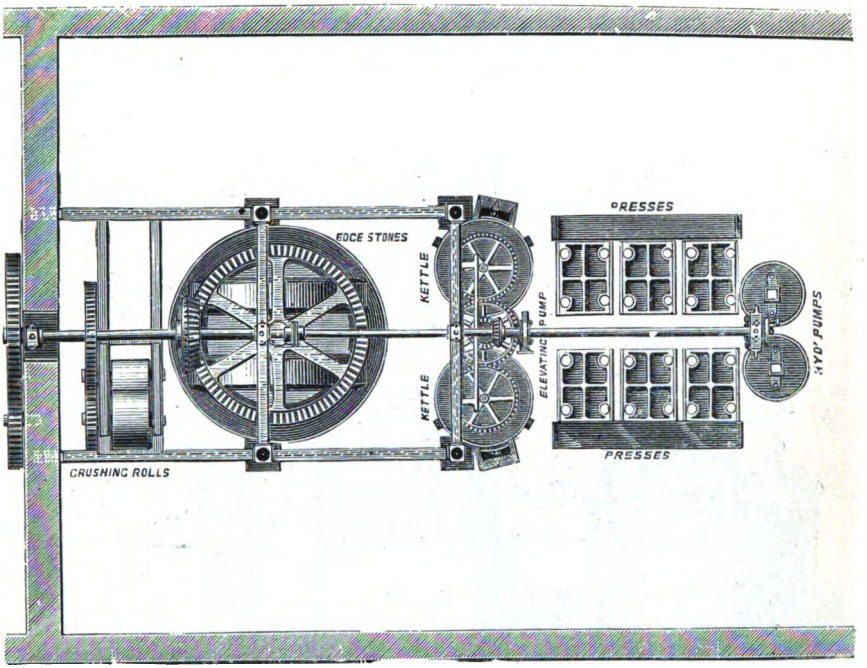


Fig. 6138.

OIL MILLS.—Fig. 6138 illustrates the best known construction and arrangement of machinery and, whether the mills are of the larger or smaller capacities for which approximate estimates are given, is mainly a question of the proportions of the machines, and the number of presses requisite to treat a given quantity of seed in a given time.

The mill illustrated in plan is capable of treating 5 to 6 tons of linseed in a day of about 11 hours and, as there arranged, the main driving shaft is carried in a wall box, the main driving wheel being in the engine room which adjoins the mill house. But, if desired, the machinery is arranged to be entirely self-contained and to require no support from the walls of the mill house.

The machinery for the mill illustrated, to crush 5 to 6 tons of linseed per day or an equivalent quantity of oil producing seeds, comprises :—

A sack hoist, seed screening machine, a set of seed crushing rolls, edge runner mill with driving gear, one large seed kettle (or two smaller ones) with automatic discharge, a set of self-contained double pumps with automatic knock off motion, pressure gauge, connecting pipes, &c. Six hydraulic presses to make cakes 29 in. long and tapering from 10½ to 7½ in. width, 24 patent envelopes, bagging and yarn, oil pump and tank, oil storage tanks, gearing for driving the whole of the machinery and all pipe connections, valves, &c. required. The engine is of the horizontal type, the boiler is of steel and of ample capacity to supply steam to the engine and heating kettle.

The mills of smaller capacity are similar to that above described, excepting only that the dimensions and number of machines are in proportion with the smaller output.

PRICES OF OIL MILLS, TYPE Fig. 6138.

Crushing capacity per day .. .. tons	1½ to 2	2 to 3	5 to 6
Floor space required .. .. .. feet	33 by 23	33 by 30	35 by 30
Mill men required	two	three	five
Price of machinery	£800	£1130	£2630
Price of galvanized iron mill house	£80	£100	£110
Approximate weight .. .. .. tons	24	38	97

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

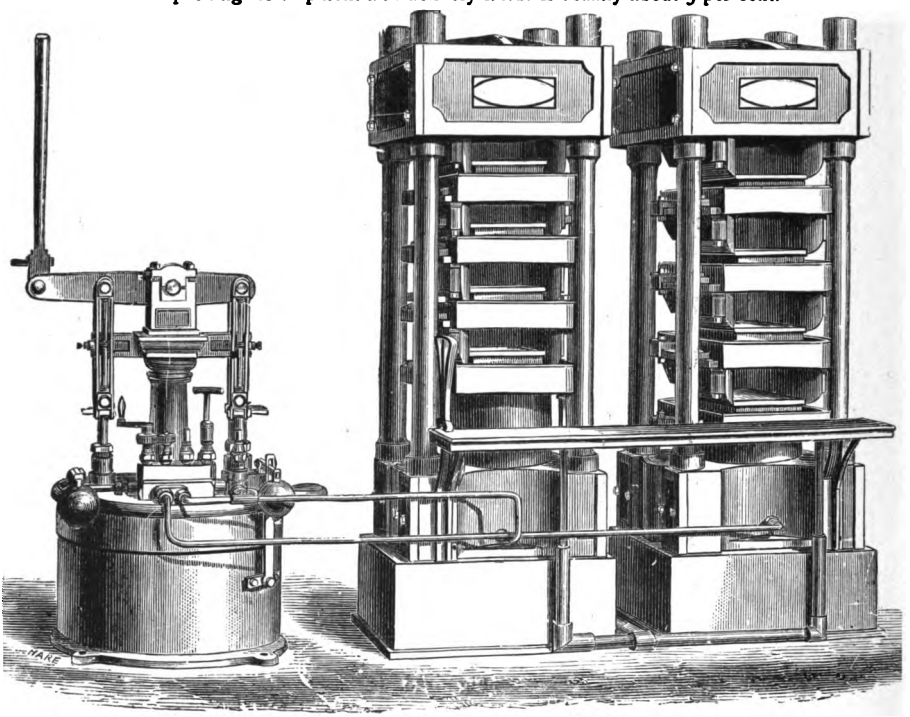


Fig. 6139.

OIL MILL PRESSES of the type illustrated by Fig. 6139 are made with four, five or six boxes, each to produce a cake about 29 in. long, tapering in width from 10½ to 7½ in. The mean weight of cakes made from good linseed is about 8 lbs. each; the output per hour from a group of three 4 box presses worked by a man and a boy should be about 700 lbs. per hour, the quantity increasing in proportion with the number of boxes used.

When working other qualities or kinds of seed, the weight of cake necessarily varies and may range from about 6½ lbs. to near double that weight.

The output from cotton seed will probably be about 575 lbs. and that from seeds which require to be worked twice, such as rape and gingelly, about 420 lbs per hour.

PRICES OF OIL MILL PRESSES, Fig. 6139.

Number of boxes	4	5
Price of press with ram 12 in. diameter	£98	£100
Do. do. do. do. steel cylinder ..	£110	£117
Do. do. 14 in. do.	£137	£147
Do do. do. do. steel cylinder ..	£161	£168

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

OIL MILL PRESS as above, but with five boxes to make cakes about 20 in. long and tapering from 7⅞ to 5¼ in. in width. The cylinder is made of special cast metal, the ram is 8 in. diameter and the price is £63.

ANGLO-AMERICAN OIL MILLS are made of all capacities and, as usually constructed, are entirely self contained, requiring no expensive foundations or support from the walls of the mill house.

A plant to treat 5 to 6 tons of linseed per day of 10 to 11 hours by this system comprises a set of 5 high speed crushing rolls, Fig. 6141, automatic feed to the elevator which delivers the crushed seed into the steam kettle with automatic delivery, a steam moulding machine, Fig. 6142, a set of hydraulic pumps with automatic knock off motion, two hydraulic presses of the type Fig. 6143 to make at one operation twelve cakes, each weighing from 9 to 11 lbs, a paring machine to dress the cakes, appliances for reducing the parings to meal, receiving tank and pump for delivering the oil to a storage tank (provided by the purchaser), all pipes, shafting, pedestals and driving gear with supports for same, engine to drive the machinery, steel boiler complete with mountings, &c. and of ample capacity for supplying steam to the engine and the steam kettle.

Oil mills of larger capacity than that referred to in the foregoing description are similar to it in general arrangement, but the quantity and construction of the machinery is in proportion with the larger output and, the greater this is, the less should be the percentage rate required to cover working expenses.

APPROXIMATE PRICES, &C. OF ANGLO-AMERICAN OIL MILLS.

Capacity of mill per day .. .. tons	5 to 6	8 to 9
Mill men required	2	3
Floor space occupied .. .. feet	36 by 16	35 by 28
Price of machinery	£1170	£2720
Approximate weight of machinery .. .. .. tons	25	78
Price of galvanized iron mill house	£60	£100

The cost of packing for shipment and delivery f o.b is 5 per cent.

MILL HOUSES.—When existing buildings are not available, a galvanized iron structure answers every purpose, and the approximate cost of the house complete with doors, windows, &c. will be found in the table. If offices, grain stores or accessory buildings are required, the approximate cost of these will be found on reference to Section V.

SMALLER OIL MILLS on the Anglo-American principle are used with great advantage, on estates and elsewhere, for the treatment of quantities of oil producing seeds and kernels within the limits specified, mentioned in the following remarks.

The arrangement of these mills is as indicated in Fig. 6140 excepting that, for crushing small seeds, a set of Anglo-American rolls (Fig. 6141), takes the place of the edge runner mill which is required for some seeds and nuts. Each machine is complete with driving gear and is self contained; expensive foundations are unnecessary and the space occupied (about 16 ft. square) is so limited that, even if no building is available, one can be provided at quite a small cost.

Mills of this type are capable of crushing ¾ of a ton to a ton per day of the seeds enumerated, and are made in the combinations indicated by the letters **A**, **B**, **C** and referred to in the following description **A**, **B** and **C**, 1 to 3 respectively.

The table **A1** refers to machinery adapted for treating linseed, rape seed, hemp seed, gingelly, sunflower and most small seeds. The plant consists of a set of seed rolls, steam kettle with automatic discharge, double hydraulic pumps driven by power, hydraulic press to make, at one operation, five cakes 18 in. long and tapering in width from 8 to 7 in. Steam engine and gear for driving the machinery, a steel boiler to supply steam to the engine and kettle, pipe connections and all necessary fittings.

The table **B1** refers to a plant as above, but with horse or bullock driving gear in lieu of the steam engine. The boiler is of the capacity required to supply the steam kettle.

The table **C1** refers to the same machinery with pulleys, &c. for driving the mill from an existing engine or other motor which should give off about 6 effective horse power. No boiler is provided for heating the kettle and the cost of this, if required is £25.

The tables **A2**, **B2** and **C2** refer to machinery arranged as (respectively) described above and provided with appliances for working copra and undecorticated castor seed.

The mills **A3** **B3** and **C3** are adapted for working half-a-ton to 1 ton per day of olives, copra and undecorticated castor seed, and they are made in the several combinations already described.

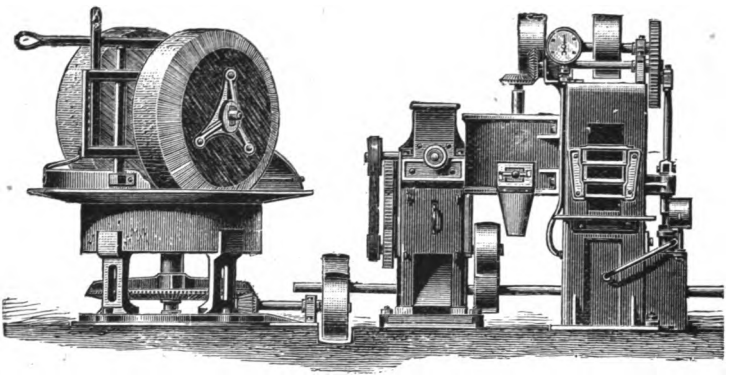


Fig. 6140.

One man can work any of the mills and the consumption of wood or other fuel necessarily varies but will probably be equivalent to about 5 cwt. of coal per day.

Other combinations of these mills are made for treating ground nuts, &c., but those described are the types in general use.

ACCESSORIES AND SPARE PARTS.—An equipment of driving straps, bagging and yarn, spare cup leathers, a few tools, &c. is worth from £20 to £25.

PRICES OF OIL MILLS, Fig. 6140.

Type of Mill	A	B	C
Price of plant to description 1	£265	£210	£155
Ditto ditto 2	£345	£295	£235
Ditto ditto 3	£305	£250	£195

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

OIL MILL MACHINERY.—The space available is too limited to admit of this subject being treated in much detail or of illustrating the various modifications required for the proper treatment of some kinds of seeds. But every user of oil mill machines is so familiar with their construction, that the following descriptions, with the approximate prices of the several appliances in general use, will no doubt answer every purpose.

DECORTICATING MACHINES for separating the husk and other waste matter from cotton seed, castor seed, ground nuts (arachides) and other oil producing kernels, vary so much in design and arrangement that the best way of ensuring satisfactory results is to send samples of the seeds or nuts to be treated, together with information as to the localities where they are produced, the quantity to be treated in a given time, &c.

COPRA DISINTEGRATORS are made to treat various quantities of nut, from about 5 to 14 tons per day, and their construction is so well known that but little description will be requisite.

The nut, with the husk as gathered having been opened by the **Cocoa Nut Splitting Machine**, the kernel is fed into a hopper attached to the iron casing which surrounds the beaters, these revolving at a very high speed, rapidly reduce the nut to the floury condition required for its further treatment.

PRICES OF COPRA DISINTEGRATORS.

Capacity of machine per day .. .. tons	5	8	14
Price of machine	£60	£95	£170
Ditto automatic feed motion	£10	£12	£17
Approximate weight .. .. .. tons	1	2	4½

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

EDGE RUNNER MILLS consist of a pair of Derbyshire grit millstones, revolving in a circular cast iron pan and rotated by a vertical spindle and gear, as indicated in Fig. 6140, or by strap if more convenient.

The stones are connected by a strong centre piece, which rises or falls freely on the central spindle, to suit the charge of seed on the pan and allow the sweepers to turn it over as the stones rotate.

PRICES OF EDGE STONE MILLS.

Diameter of edge runner .. .. feet	3	4	5	6	7
Thickness ,, ,, ... inches	10	12	14	15	16
Price of mill	£55	£75	£90	£140	£200
Approximate weight .. .. tons	¾	1¼	2½	4½	6

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

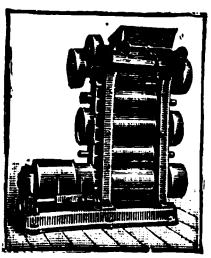


Fig. 6141.

ANGLO-AMERICAN SEED CRUSHING ROLLS.—Fig. 6141 represents a type of rolls very largely used for crushing most kinds of seed and, with certain modifications, for crushing kernels, working olives, &c.

The seed is fed into the hopper and guided by a fluted roller to the upper pair of close grained cast iron crushing rolls and thence, by a guide plate, to the next pair and so on to the bottom pair where the meal is discharged, perfectly ready for steaming in the kettle.

Each machine is complete with appliances for adjusting the roller pressure and all driving pulleys, strap guides, &c. If the rollers are made of chilled cast iron the extra cost is about 10 to 15 per cent.

PRICES OF ANGLO-AMERICAN SEED ROLLS.

Diameter of rolls .. .. .. inches	8	12	16	16
Length ,, ... ,,	8	15	30	42
Price of 3 high machine	£38	..	..	..
,, 4 ,, ,, ...	£42	£110	£210	£255
,, 5 ,, ,, ...	..	£120	£233	£290

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

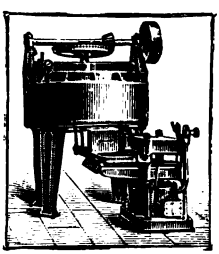


Fig. 6142.

SEED HEATING KETTLES, Fig. 6142.—As indicated in the introductory remarks, the crushed seed is heated in a steam jacketted kettle to liquify the oil before it is expressed in the hydraulic press.

The pans are usually made of cast iron and of various dimensions, some of which are referred to in the following table; a faced flange joint is provided for connecting the jacket with the steam pipe from the boiler; also the vertical shaft with bearings and gear to drive the stirrers; the discharge pockets are fitted with valves for filling the bags ready for pressing.

If the pans are felted and encased with planished sheet iron, the extra cost is about 15 per cent.

PRICES OF SEED HEATING KETTLES, Fig. 6142.

Diameter of pan .. .. .. inches	20	36	42	48	51
Price of kettle	£22	£32	£35	£45	£50

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

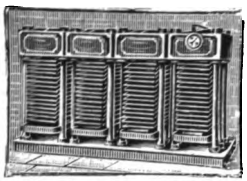


Fig. 6143.

ANGLO-AMERICAN OIL PRESSES, Fig. 6143, fitted with corrugated metallic plates in lieu of the boxes shown in Fig. 6139.

As it is well known (and referred to on previous page) this system offers great advantage in regard to economy in working expenses, in wear and tear, and in increased output. The numbers of cakes stated in the following table are of course, those made at each operation.

PRICES OF ANGLO-AMERICAN OIL PRESSES, Fig. 6143.

Number of Cakes made	12	14	16	18
Price of press with ram 12 in. diameter	£125	£130	£140	£150
,, ,, 14 in. ,, ...	£165	£175	£185	£190
,, ,, 16 in. ,, ...	£200	£210	£226	£230

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

OIL PRESS BAGGING varies in price proportionately with the price of wool. The width and weight per yard should be stated.

OLIVE OIL MILL PLANT.—The undermentioned machinery, made and erected by the writer, has been in successful operation for several years in working for the public, at tariff rates payable (for the most part) in a proportion of the oil produced.

The engine is of the horizontal type of 25 nominal horse power with jet condensor and all accessories.

Two Lancashire boilers each of 30 nominal horse power and constructed for a working pressure of 80 lbs. per square inch; the fittings are of the type recommended by the Boiler Insurance Co.'s and include feed pump and injector.

Shafting, pulleys, &c.—A line of main shaft, graduated from 4½ to 3 inches in diameter, extends the whole length of the building and is complete with bearings, pulleys, belts, &c. to each set of pumps.

Edge stones.—Three pairs of Scotch granite millstone runners 18 inches thick revolve on Scotch granite bed stones, surrounded by a plate with door for discharging the crushed olives and appliances for lowering the runners as the bed stones wear.

The presses.—Nine presses of the type Fig 6139 are placed side by side nearly the whole length of the press house and all arrangements are made for easily removing the spent olives. The cylinders are of steel, the rams are 10 inches diameter, the stroke is 3 feet and the clear space between the table and platen is 5 feet.

Hydraulic Pumps.—Five pumps of the type of Fig. 6139 with their pipe connections are so arranged that the hydraulic pressure is easily controlled and that any of the nine presses may be worked by any pump. The rams are 1¼ and 2 inches diameter and each press is complete with automatic knock off gear, valve, pressure gauge, &c.

Oil Tanks.—A separate tank provided for each press is made of wrought iron plate ⅜ inch thick and 3 ft. by 2 ft. 6 inch deep with a central diaphragm dividing the tank into two compartments

The cost of a plant of machinery to the foregoing outline specification is—£4963.

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

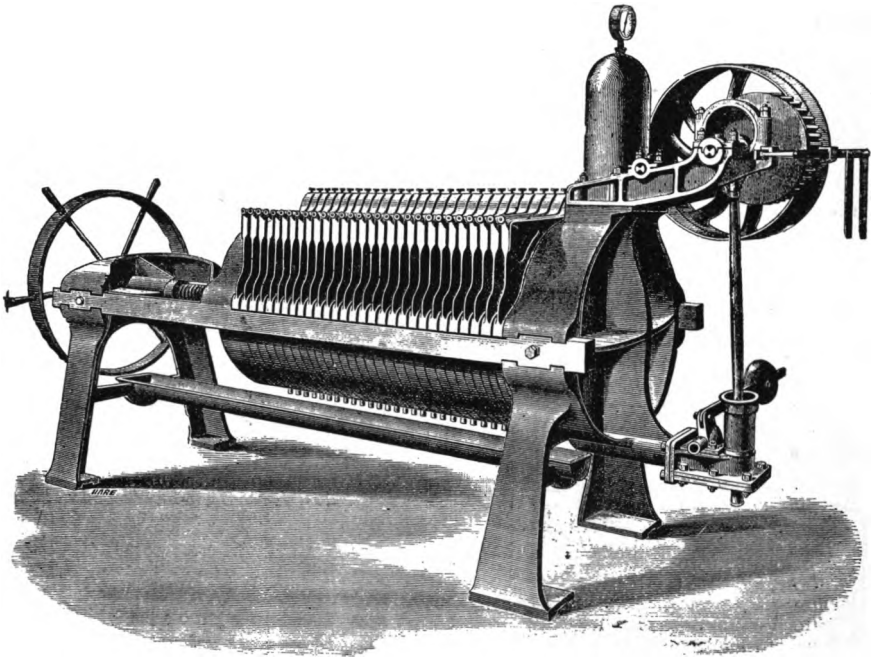


Fig. 6144.

HYDRAULIC FILTER PRESSES (referred to elsewhere) must again be mentioned in connection with the production of oil from various kinds of vegetable, animal and mineral matter. The presses are entirely self contained whether they are driven by belt, as shown in Fig. 6144, or complete with engine as described later on. By certain modifications a number of presses may be supplied with pressure from an accumulator, or each press may be complete with pump to work by manual labour.

Linseed or rape seed worked as taken from the kettle and at a temperature of 70 deg. F. is ready for sale as it comes from the press without incurring the expense of storage, and an 18 chamber, 36 inch machine will express about 10 tons of linseed oil per day; a 36 chamber machine produces about 20 tons and the yield from rape seed is about half these quantities.

Animal Oils, such as tallow, &c. are obtained by filtration after the melted material has been allowed to cool to about 70 deg F. The presses are also used for filtering by the cold process and horse oil so obtained, remains clear at a temperature of 32 deg. F.

Mineral oils.—The paraffin scale is collected by this process and it is also used for purifying and decolourising the vaseline obtained from petroleum.

The Belt Driven Press illustrated by Fig. 6144 is complete with hydraulic pump, relief valve, accumulator, pressure gauge, oil trough, fast and loose pulley, strap guide, &c.

Filter Press with Engine.—This is in all respects like Fig. 6144 excepting that a steam cylinder is attached to the end plate of the press. A balanced disc crank is keyed on the end of the driving shaft, and transmits power for working the machine, in lieu of the pulleys shown on the other end of the shaft.

It will be evident that presses of this type can be fixed in any position desired and save the cost of the shafting, pulleys and belts. There is the further advantage that the exhaust steam may be utilized to maintain the temperature requisite for efficient working, reference to which has been made in the foregoing remarks.

PRICES OF FILTER PRESSES 27 INCHES DIAMETER, TYPE Fig. 6144.

Number of plates	12	18	24	36
Filtering area .. .. square feet	88	132	176	264
Price of press, belt driven	£80	£90	£105	£130
Ditto with engine	£90	£105	£115	£140

PRICES OF PRESSES AS ABOVE BUT 36 INCHES DIAMETER.

Number of plates	12	18	24	36
Filtering area .. .. square feet	161	241	322	483
Price of press, belt driven	£160	£180	£200	£240
Ditto do. with engine	£180	£200	£220	£260

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

Filter press without pumps.—These are constructed to work in series and to be supplied with pressure from an accumulator, or from a special pumping engine. For the filtering area of each size of press see the foregoing tables.

PRICES OF FILTER PRESSES, 18 INCHES DIAMETER WITHOUT PUMPS.

Diameter of plates .. .. inches	27	36
Price of press with 12 plates	£50	£120
Ditto do. 18 ,, ...	£65	£140
Ditto do. 24 ,, ...	£75	£160
Ditto do. 36 ,, ...	£100	£200
Ditto pumping engine	£35	£50

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

Filter Press with hand Pump.—The machine is similar in construction to Fig. 6144, but the plates are 18 inches diameter and the pressure pump is attached to the side frame and is worked by a lever.

A smaller press (15 inches diameter) is made and the prices are about 25 per cent. less than for the 18 inch press but the filtering area is relatively smaller and the last named size is usually preferred.

PRICES OF FILTER PRESSES WITH HAND PUMPS.

Number of plates	12	18	24	36
Filtering area.. .. .. .. square feet	42	63	84	126
Price of press	£25	£30	£35	£50

The cost of packing for shipment and delivery f.o.b. is usually about 6 per cent.

Cloths for Filter Presses.—These are not included in any of the foregoing prices the cost of the several qualities and sizes made will be (at present prices) as follows—

Diameter of press .. .. .. inches	15	18	27	36
Swansdown .. .. .. per doz	£0 17 0	£1 0 0	£2 0 0	—
,, ,, ... super ,,	£1 2 0	£1 7 0	£2 15 0	£4 16 0
,, ,, ... extra super ,,	£1 10 0	£2 0 0	£4 0 0	£6 0 0
Twill ,, ... ,,	£0 13 0	£0 16 0	£1 10 0	£2 8 0
Hydraulic twill .. .. .. ,,	£1 6 0	£1 12 0	£3 0 0	£4 16 0
Chain .. .. ,,	£0 17 6	£1 0 0	£2 0 0	£3 3 0

The cost of packing for shipment and delivery f.o.b. varies according to destination, quantity required &c., but it rarely exceeds 5 or 6 per cent.

PIPE MAKING MACHINERY.

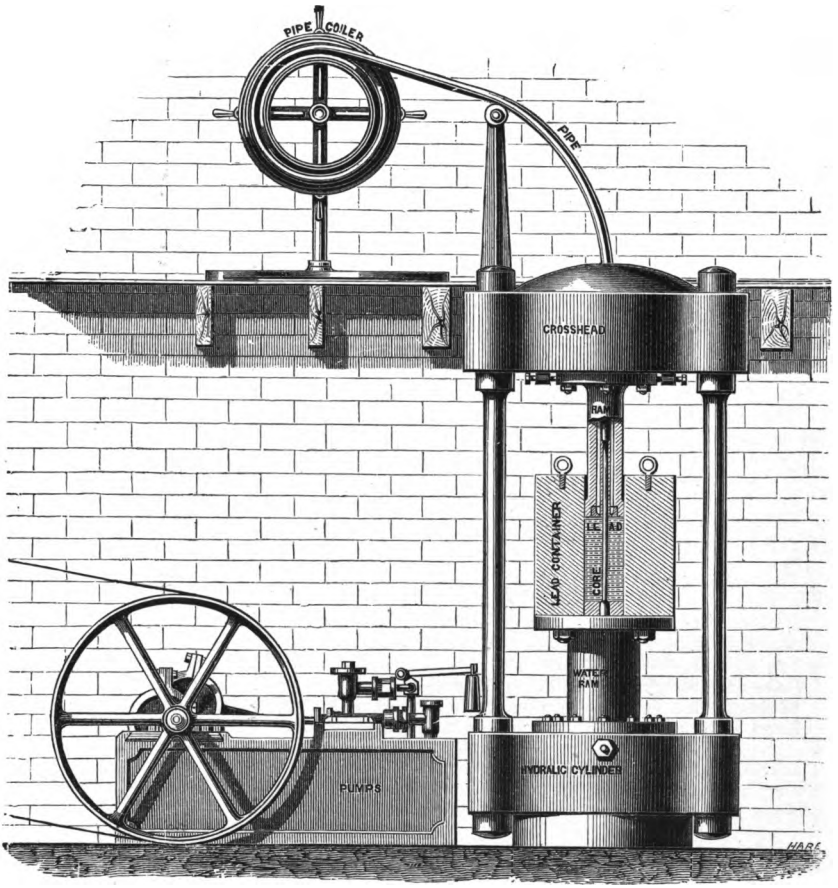


Fig. 6151.

PIPE MAKING PLANT of the type illustrated by Fig. 6151 produces **lead, block tin, tin lined** and **composition** pipes and—with slight modifications—it is available for the other purposes referred to later on.

The engraving illustrates the upward process in which the pipe is coiled above the machine but, if desired, it can be arranged to work in the opposite direction, the drum on which the finished pipe is coiled being, in that case, below. The mode of working is as follows :—

The molten metal is poured into the container and, when solidified, is forced upwards by hydraulic pressure against the die which is fixed to the crosshead. The core which forms the bore of the pipe is fixed centrally in the container, so that the pressure against the die forces the metal into the space between the core and the die, and forms a continuous pipe until the metal in the container has been exhausted; it then returns to its original position and is re-charged for another operation.

All appliances are provided for rapidly changing the dies, for making pipes of different sizes and for carrying out the process with ease and safety.

The pipes produced by this process are perfectly concentric and the density of the metal, due to the mode of manufacture, ensures smooth surfaces and superior finish.

TIN LINED PIPES entirely remove all risk of contamination with lead and, for this reason, are largely used for domestic and other purposes; they also possess the further advantage of being very much lighter than lead pipes to carry equal pressures. See tables in Section 7.

The machinery above referred to for making tin lined pipes ¼ to 2 in. diameter, lead composition pipes ¼ to 1 in. diameter and lead pipes ¼ to 6 in. diameter, consists of:—

Hydraulic Press with four turned steel columns supporting the crosshead, standard and guide pulley for pipes.

Intermediate ram, for changing the cores without removing the container, and gun metal motion work.

Quick return motion to press ram, automatic stopping gear and all levers, valves, &c. for stopping and reversing motions.

Horizontal treble barrel pressure pump on iron cistern and complete with pulley for belt, safety valve, hydraulic gauge, pipes and accessories.

Four coiling drums for coiling pipes, with sole plate, wrought iron fittings, &c.

Hydraulic jib crane with chains, hooks, &c. for conveying the molten metal to the container, complete with valves, levers and connections.

Lead melting furnace and fittings comprising, the iron and brick work and melting pot with spout, valve and hand wheel.

Steel containers, dies and cores, core seats, &c. for making lead pipes ¼, ⅜, ½, ⅝, ¾, 1, 1¼, 1½, 1⅝, 2, 2¼, 2½, 3, 3½, 4, 4½, 5 and 6 in. diameter; also for making block tin and tin lined lead pipes from ¼ to 2 in. diameter.

Block tin melting furnace with accessories.

Melting furnace for tin lined lead pipes with ingot mould, melting pot, mountings, mandrills for pipes and appliances for drawing them

The output, &c.—The machinery to the foregoing description is capable of producing about 25 tons of pipes per week, and requires about 10 horse power to drive it.

The approximate cost of the plant is £1,020.

The weight is about 28 tons and the cost of packing for shipment and delivery f.o.b. is 5 per cent.

If the pressure pumps are complete with their own steam engine the cost is about £100 extra.

For a set of machinery adapted for making composition pipes from ¼ to 1 in. diameter and lead pipes from ¼ to 3 in. diameter, and for an output of about 25 tons per week, the cost is £635.

The weight is about 22 tons and the cost of packing for shipment and delivery f.o.b. is 5 per cent.

Special estimates will be required for machinery to produce other combinations of sizes or of kinds of pipes, which purchasers will please to specify.

The same machinery is used for:—

Covering telegraph cables with lead.

Making lead rods for ammunition and **leads for window glass.**

Lead wire and lead pipes of various shapes and sections.

LEAD ROLLING MILLS are made to roll sheets up to 9 ft. wide and 40 ft. long and complete with reversing mill engines, automatic feed, cutters to trim the edges and guillotine for dividing the sheets, rising and falling tables, &c.

BOLT, NUT, NAIL AND SCREW MAKING MACHINERY.

The variations in the designs for appliances for these purposes are rather in details than in principles of construction, and those about to be referred to combine all improvements which long experience in the production of high class work has indicated as desirable.

The cost of the machines, their capacity of production and the working power required, is given separately and with sufficient accuracy to admit of estimates being made, whether for the establishment of works for this branch of manufacture or to supply the occasional or (relatively) smaller demand in the works of bridge builders, boiler makers, &c.

The approximate output, given in the following tables, is that which may be expected where the machines are worked with the ordinary facilities and skill and the driving power required will be found to be over—rather than under—stated.

The accessories, such as hearths, furnaces, small tools, &c. are inexpensive and are usually provided by the purchasers.

BOLT AND RIVET HEADING MACHINES consist of two strong standards, attached to a foundation plate, each carrying two sets of heading tools; these will produce work of four different kinds or they may all be used for making simultaneously one size and shape of bolt or rivet.

The machine is complete with fast and loose pulley, driving gear and levers and one pair of heading tools. The latter are easily made and are almost always provided by the purchasers.

The heads of bolts or rivets with round necks are finished at one stroke of the machine and those with square or hexagon necks at two strokes.

PRICES OF BOLT AND RIVET HEADING MACHINES.

To make bolts in diameter from .. inches	⅜ to ¾	½ to 1	¾ to 1½
Price of machine	£97	£120	£145
Approximate output per hour	400	370	320
Ditto H. P. required	1½	2	2½
Ditto weight .. .. .. tons	3½	5	6½

The cost of packing for shipment and delivery f.o b. is about 5 per cent.

NUT MAKING MACHINES, described below, turn out perfectly formed nuts with a minimum of waste, 17 to 18 cwt. of finished work being produced from one ton of iron.

This object is attained by using two punches which meet centrally in the nut being formed, and expand it externally whilst the metal is under compression in every direction. This greatly increases the density of the finished nut as will be understood from the fact that nuts for bolts of ¾ in. diameter are $\frac{1}{16}$ in. wider and $\frac{1}{16}$ in. thicker than the bar from which they are made and other sizes in similar proportions.

PRICES OF NUT MAKING MACHINES.

To make nuts from .. .. inches	¼ to ⅜	⅜ to ⅝	½ to 1	½ to 1¼
Price of machine	£35	£68	£95	£120
Tools for each size	£1 7 6	£1 10 0	£2 0 0	£2 5 0
Approximate output per hour	1100	850	720	650
Ditto H. P. required	¾	1½	1¾	2
Ditto weight .. .. tons	1	1¾	3	4

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

FRAZING MACHINES to take off the "fin," or other inequalities, left by the dies on nuts or bolt heads. This tool turns out a large quantity of work and the driving power required is much less than 1 horse power.

The price of nut frazing machines is £12 10 0
Ditto bolt head frazing machines is £13 15 0

HORIZONTAL FOUR SPINDLE BOLT SCREWING MACHINES are provided with self-acting appliances which can be set to cut any desired length of screw, and thrown off automatically when that length has been cut.

The spindles can be used for screwing the same, or each for a different diameter of bolt and the length of cut can, in each case, be regulated by the self-acting, or by hand motion.

The output is usually about 200 bolts of ⅞ in. diameter per hour and is greater or less in proportion with the size of work, length of cut, &c.

The price of a machine to screw bolts up to 1 in. diameter is £40 0 0
The power required is about 1 horse power and the approximate weight is 1 ton.
The cost of packing for shipment and delivery f.o.b. is 5 per cent.

VERTICAL FOUR SPINDLE NUT TAPPING MACHINES will tap four sizes of nuts at the same time and. to adapt it for this purpose, two of the tapping spindles run at a higher speed than the other two. The machine is self contained on a strong iron frame with oil trough, levers to start or stop any of the spindles for changing work, fast and loose pulley, belt guide, &c.

The four spindles are attended to by one boy or girl, and the tool is usefully employed where moderate quantities of several sizes of nuts are required.

PRICES OF VERTICAL FOUR SPINDLE TAPPING MACHINES.

To tap nuts for bolts, diameter .. .. inches	½ to 1	¾ to 1½
Price of machine	£26	£39
Approximate output per hour	500	300
Ditto H.P. required	½	½
Ditto weight .. .. cwts.	12	18

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

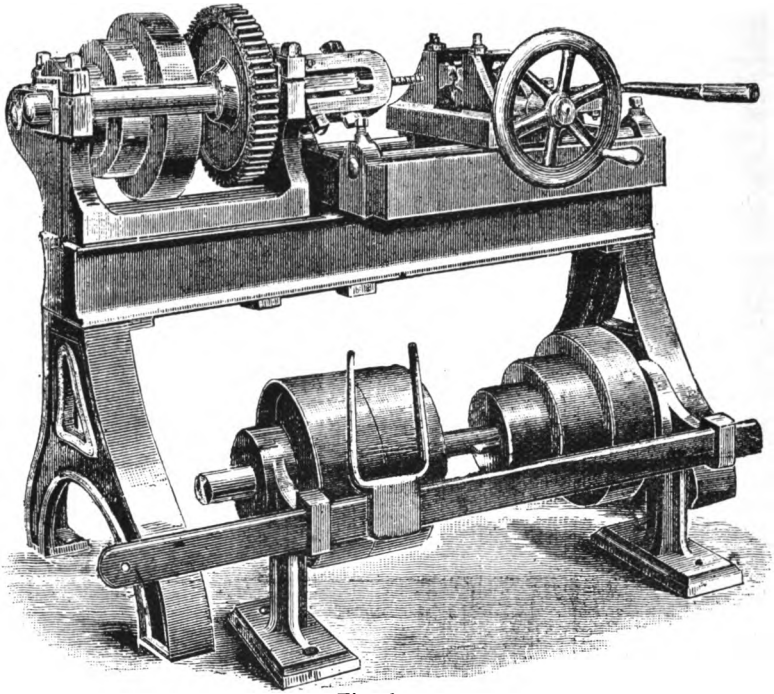


Fig. 6152.

HORIZONTAL OPEN DIE SCREWING MACHINES (Fig. 6152) to screw bolts, studs, set screws or nuts from $\frac{3}{8}$ to $\frac{3}{4}$ in. diameter at one cut, or $\frac{7}{8}$ in. diameter at two cuts.

The clamps which grip the work cannot get out of the centre line of the dies, and appliances are provided to ensure uniformity in diameter. Hexagon or square head set screws are held in chucks and the thread can be cut close up to the head.

Each machine is complete with speed cones for driving, overhead motion and strap guide and one pair of clamps and dies. The cost of extra taps and dies will be found in the table relating to them.

The driving power required is about $\frac{1}{2}$ horse power and the output averages about 220 bolts or set screws per hour, and a relatively smaller number of studs screwed at both ends.

The price of the machine is £28 0 0

The approximate weight is 15 cwt. and the cost of packing for shipment and delivery f.o.b. is 5 per cent.

BELT DRIVEN BOLT SCREWING MACHINES.—The proportions of the pulleys are sufficient to drive the machine, without the intermediate gear required in the tools previously referred to, with the object of rapidly and economically turning out small bolts; the driving power required is very small.

PRICES OF BELT DRIVEN BOLT SCREWING MACHINES.

To screw bolts in diameter from inches	$\frac{1}{4}$ to $\frac{3}{8}$	$\frac{7}{16}$ to $\frac{5}{8}$	$\frac{5}{8}$ to $\frac{3}{4}$
Price of machine	£12	£16	£20

The cost of packing for shipment and delivery f.o b. is about $7\frac{1}{2}$ per cent.

TWO SPINDLE BELT DRIVEN NUT TAPPING MACHINES will tap nuts for bolts from $\frac{1}{4}$ to $\frac{7}{16}$ or $\frac{1}{2}$ in. diameter and both spindles are driven by one belt passing over and under the pulleys on the respective spindles.

The machine is complete with cast iron supports, iron oil trough, &c. The output varies from 300 to 500 nuts per hour and ¼ horse power is ample for working the machine.

The price of the machine is £10 10 0

The weight is about 6 cwt. and the cost of packing for shipment and delivery f.o.b. is 8 per cent.

TAPS AND DIES for the bolt and nut making machines, referred to in the foregoing descriptions, are supplied at the undernamed prices, the cost of intermediate sizes, whether in English or metrical dimensions, being charged at intermediate prices.

PRICES OF TAPS AND DIES FOR BOLT AND NUT MAKING MACHINES.

Diameter of bolts .. .. inches	¼	⅜	½	⅝	¾	⅞	1	1¼	1½
Price of taps .. .. each	1/4	2/-	2/8	3/4	4/-	4/8	5/4	6/8	8/-
Ditto dies .. per pair	3/-	4/6	6/-	7/6	9/-	10/6	12/-	15/-	18/-

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

PLANT FOR A BOLT, NUT AND RIVET FACTORY, equal to an output of about 7,000 bolts of any size up to 1 in. diameter, and an equal number of nuts, in 10 hours.

The following details relative to plant in successful operation, will serve as a basis for estimating the cost of machinery equal to a larger output, and the working expenses may be ascertained with sufficient accuracy, by reference to the number of hands employed in the several processes, which is given in each case.

Cutting off machine—worked by one man—with gauges for cutting to dead lengths, driving pulley, &c.

Heating furnace—one man or youth—for heating the bolt or rivet iron, complete with all the metallic work and drawings for setting.

Bolt and rivet forging machine—one man or youth—with foundation plate and holding down bolts; also a set of tools for making bolts with hexagon heads, square heads, cup heads with square necks for ⅜, ½, ⅝, ¾, ⅞ and 1 in. diameter for each kind, two pairs of tongs, two pairs of pliers, spanners, driving pulley, &c.

Double frazing machine—two boys—to clean off the "fash" or fraze on the heads of bolts as they leave the heading machine and two pairs of tongs.

Nut forging machine—one youth—with foundation plate and holding down bolts; also a set of tools for making hexagon and square nuts for bolts ⅜, ½, ⅝, ¾, ⅞ and 1 in. diameter, spanners, split pulley, &c.

Nut frazing machine—one girl—with foundation plate and holding down bolts and complete with chucks for hexagon and square nuts for bolts ⅜ to 1 in. diameter, as above, spanners, driving pulley, &c.

Bolt pointing machine—one girl—(required for good work) is complete with foundation plate, &c. and tools for pointing or turning the ends of bolts with hexagon, square, or cupped heads from ⅜ to 1 in. diameter, spanners, driving pulley, &c.

Two quadruple bolt screwing machines—two girls for each machine—with foundation plates, &c., and screwing dies and chucks for bolts ⅜ to 1 in. diameter for each machine, spanners, driving pulleys, &c.

Two quadruple nut tapping machines—two girls—with foundation plate, &c., and chucks for hexagon and square nuts and two taps for each size, as above, from ⅜ to 1 in. diameter, spanners, driving pulleys, &c.

Blowing fan with foundation plate, &c., countershaft and fast and loose pulley, main driving pulley, strap guide, &c.

Horizontal engine with cylinder 10 in. diameter with turned fly wheel, governors, feed pump, foundation bolts, &c.

Driving gear consisting of the main driving pulley, about 75 ft. of bright shafting, pedestals for same with gun metal bearings and lubricators, turned couplings, collars with set pins.

The approximate cost of the machinery comprised in the foregoing specification is £670.

The weight is about 25 tons and the cost of packing for shipment and delivery f.o.b. is 5 per cent.

NAIL MAKING MACHINES vary considerably according to the kind of nails required, and the following remarks will be limited to appliances for producing the "French nails" (pointes de Paris) now so universally used.

The machines make round, square or triangular nails in iron, steel, copper or other metal, and the same machines can be adopted for making rivets of any diameter or length within the capacity of the tools, as indicated in the following table.

All parts liable to much wear and tear are made of wrought iron or forged steel, and the machines are complete with cast iron foundations for bolting to the floor, fly wheel, pulley, &c. and they are always tested, by making nails, before delivery.

The data as regards the power required to drive the machines, the approximate average output and the floor space occupied, will enable purchasers to determine the size and number of machines to be put down, without loss of time in correspondence; it may however be mentioned that the driving power is in excess of that required where a number of machines are employed, and that the rates of output are below those frequently obtained in practice. The tools are easily arranged to work equivalent lengths and sections in metrical measures.

PRICES OF NAIL MAKING MACHINES.

To produce nails in length .. inches	½ to 1½	½ to 1½	½ to 2	1 to 3	1 to 4	2 to 5	3 to 6
Ditto section wire gauge ..	15 & 16	13 & 14	12 & 13	9 to 11	7 to 9	5 to 7	2 to 5
Price of machine	£20	£25	£32	£42	£58	£87	£125
Approximate output per hour ..	15000	12000	9500	6000	4800	3500	2400
Ditto H. P. required.. ..	3	3	3	3	5	5	5
Ditto dimensions, length feet	4	4½	6	6	7	9	10
Ditto ditto width ,,	3	3½	3½	4½	4¾	5½	6
Ditto weight .. .. cwt.	4	5	6	10	16	26	30

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

CUT NAIL MAKING.—The machines for this purpose (not illustrated) are entirely self contained and each machine is usually tended by a youth or girl.

The first three sizes have an automatic feed and those to make nails 3 in. long, and upwards, are fed by hand.

PRICES OF CUT NAIL MAKING MACHINES.

To make in length .. .. inches	1	1½	2	3	4	5	7
Ditto ditto .. .. m/m	25	40	50	75	100	125	175
Approximate output per minute ..	300	200	200	200	150	100	80
Price of machine	£40	£53	£60	£76	£107	£150	£176

The cost of packing for shipment and delivery f.o b. is about 8 per cent.

SPIRAL WIRE MATTRESS WEAVING MACHINES price each £10.

Chain wire ditto ditto ditto to work wire up to No. 14 wire gauge .. .. £30.

TWISTED LINK (JACK) CHAIN MAKING MACHINES.—The small machine makes single link chain of any gauge up to No. 14, and the two larger sizes produce double link chain within the limits indicated.

PRICES OF OPEN LINK CHAIN MAKING MACHINES.

To make chain up to W. G. No.	14	11	5
Price of machine	£30	£55	£100

STEEL WIRE MAT WEAVING MACHINES will work wire of all usual sections and make mats of the sizes in general demand. The price of the machine is £20.

The cost of packing the abovenamed machines and delivery f.o.b. for shipment varies from 6 to 10 per cent.

WOOD SCREW MAKING—The first process is to form the blank; the next is to turn and point the screw, and the third is to cut the nick in the head.

The blank forming machine can also be used for making small rivets.

The worming and turning and nicking machines are equal to an average output of about 10,000 screws per day.

PRICES OF BLANK FORMING MACHINE.

To take in length .. .. .. inches	1	1½	3	6	6
Ditto diameter, ... gauge	12	8	5	0	⅝ in.
Approximate output per minute	200	140	100	60	50
Price of machine	£38	£57	£102	£160	£253

PRICES OF WORMING AND TURNING MACHINES.

For lengths up to .. .. .. inches	1½	6	6
For diameter up to .. .. .. gauge	8	0	⅝ in.
Price of machine	£26	£33	£38

PRICES OF HEAD NICKING MACHINES.

For lengths up to .. .. inches	1½	6
Price of Machine	£10	£15

The cost of packing for shipment and delivery f.o.b. is 8 per cent.

FOUNDRY PLANT.

The mass of materials which must, of necessity, be handled in a foundry and the relatively small margin for profit usually derived from the business, enforce rigid economy in every department and, as is well known, a judicious outlay in improvements in plant, often make the difference between a satisfactory profit and none at all.

In addition to cupolas which will bring down metal, fluid and pure, with a minimum consumption of fuel, much may be done by careful arrangements for carrying on the work and in providing lifting and other appliances which aid in increasing the output and reducing the cost of labour. It is frequently difficult to carry out all the improvements one would desire in old foundries, but it seems inexcusable not to do so in new ones.

What forms the improvements are to take, evidently must be studied in each case, but one prominent feature must be, ample appliances for lifting and handling castings, moulding boxes, dry sand work, &c. In foundries where special work, such as pipe making, plate moulding, &c. is largely carried on, swing cranes of the type Fig. 2276-8 give excellent results. But for foundries principally employed in general work, it seems unquestionable that good overhead lifting machinery should be used in preference to any other and so have a clear floor.

The following brief description of a highly successful foundry for general work (including heavy machine castings), for the design of which the Writer is largely responsible, may be considered worthy of record.

The foundry is about 120 ft. long, 45 ft. span and 32 ft. high from floor line to roof ties.

The cupolas are outside the foundry and about centrally in its length, and have drop bottoms. The metal hoist serves both cupolas and is worked by steam. The core stoves are at the back end of the moulding shop, and the metal ladles from the cupolas and the core stoves, are commanded by an overhead travelling crane of 15 tons power, driven in all motions by shaft and of the type Fig. 2262. In addition to this there are six swing wall cranes of 2 tons power and 20 ft. radius, similar to Fig. 2278. The question whether these should be worked by steam or hydraulic power was considered but, as the lift is short and men are always on the spot it was decided to work them by hand.

The overhead traveller passes over the last named cranes and provision is made for it to traverse out of the back end of the shop, to the moulding box storage ground, and to the fettling shop, so that it takes castings or boxes direct to the fettler or to the storage ground (or the reverse) as the case may be.

It was desired to work the crane, in all motions, from below and, in order to ensure a clear gangway for the attendant, without loss of space on the moulding floor, a platform about 2 ft. wide and 3 ft. high is carried along one side of the shop, and foundry tools and materials are stored under the platform instead of them being distributed over the foundry floor as they usually are.

PRICES OF CUPOLAS, LADLES, &c. and of **CRUCIBLE CUPOLAS** will be found on reference to Fig. 3148 and 3150 in Section 4.

MATCH MAKING MACHINERY.

MATCH MAKING MACHINERY suitable for making and putting up 400 gross (57,600) boxes of wood matches per day of 10 hours comprises :—

A circular saw bench with two saws, countershaft, &c., to prepare the wood for the splint and the skillet machines.

A splint machine with knives, &c. for cutting the wood match splints and two flaking machines for cutting splints, &c. from timber which is too coarse for the splint machine.

Two skillet machines for slicing the wood to form the boxes and a disc machine which makes the box bottoms.

Five filling machines for filling the frames with splints ready for dipping. One hundred and fifty dipping frames and two dipping plates.

Fourteen cutting machines for cutting the splints in halves after they have been dipped.

A parafining apparatus, a scorching plate, with fire bars and ironwork for furnaces, a composition mill, a box rim knife and two steaming boxes.

The bright steel main driving shaft, pedestals with gun metal bearings and lubricators, pulleys key seated in position for erection, driving belts from the engine and all the machines.

The steam piping and connections between the boiler and engine, also to the drying room and pipes and connections for heating it.

A fan for the drying room, complete with rope driving pulleys and all connections.

A horizontal compound high pressure engine with turned fly wheel, governors, feed pumps, lubricators, stop valve, drain cocks, &c.

A steel boiler with circulating tubes in the furnace, the longitudinal seams double riveted and complete with all mountings :—

The boiler is tested by hydraulic pressure to 160 lbs. per square inch and of ample power, when fired with wood, to supply steam to the engine and to the machines which require it.

The chimney is of wrought iron and is complete with base plate, and stays with screw adjustments.

The approximate cost of a plant to the foregoing description is .. £950 0 0

The measurement of packages is about 1,250 cubic feet and the cost of packing for shipment is 8 per cent.

The cost of a plant of machinery for turning out 200 gross (28,800) boxes in 10 hours with engine, boiler, &c., complete as above, is about £660 0 0

The measurement of packages is about 950 cubic feet and the cost of packing, &c. as above.

MATCH BOX MAKING MACHINES.—The out turn of the case machines is about 250 gross (36,000) in 11 to 12 hours, that of the drawer about 175 gross (25,200) and of the labelling machine 300 gross (43,200).

The cost of the plant is about £270 0 0

BRIQUETTE MAKING PLANT.

Machinery for converting into useful and handy fuel, the small coal which accumulates so rapidly at pit heapsteads and in merchants' yards, has long been used on the Continent of Europe with advantage alike to the producer and consumer, but until recently, this branch of machine construction has made little progress in this country. This is not now the case and probably the plant illustrated by Fig. 6153 surpasses all that has been hitherto devised in the perfection of products made from widely differing combinations of materials.

The engraving represents the arrangement of machinery used for an output of 5 to 10 tons per day but the same principle is carried out in the construction of the larger machines referred to in the following table.

The shape and weight of the briquettes may be varied to almost any extent, those for domestic use are usually from ¾ to 3 lbs. For locomotives the weight ranges from about 9 to 14 lbs., whilst for marine boilers the briquettes frequently weigh 20 or even up to 28 lbs. each. Whatever may be the size of the briquettes made by these machines, they are uniform in weight and, those of rectangular shape have rounded corners which—experience indicates—appreciably decreases abrasion and loss of weight in handling and transit.

The plant comprises a mixing and measuring machine, a disintegrator, bucket elevators, heater, pug mill with adjustable knives, briquette press and all appliances for driving (exclusive of steam engine or other motor) and no foundation is required beyond the strong timber frame on which the machines are fixed.

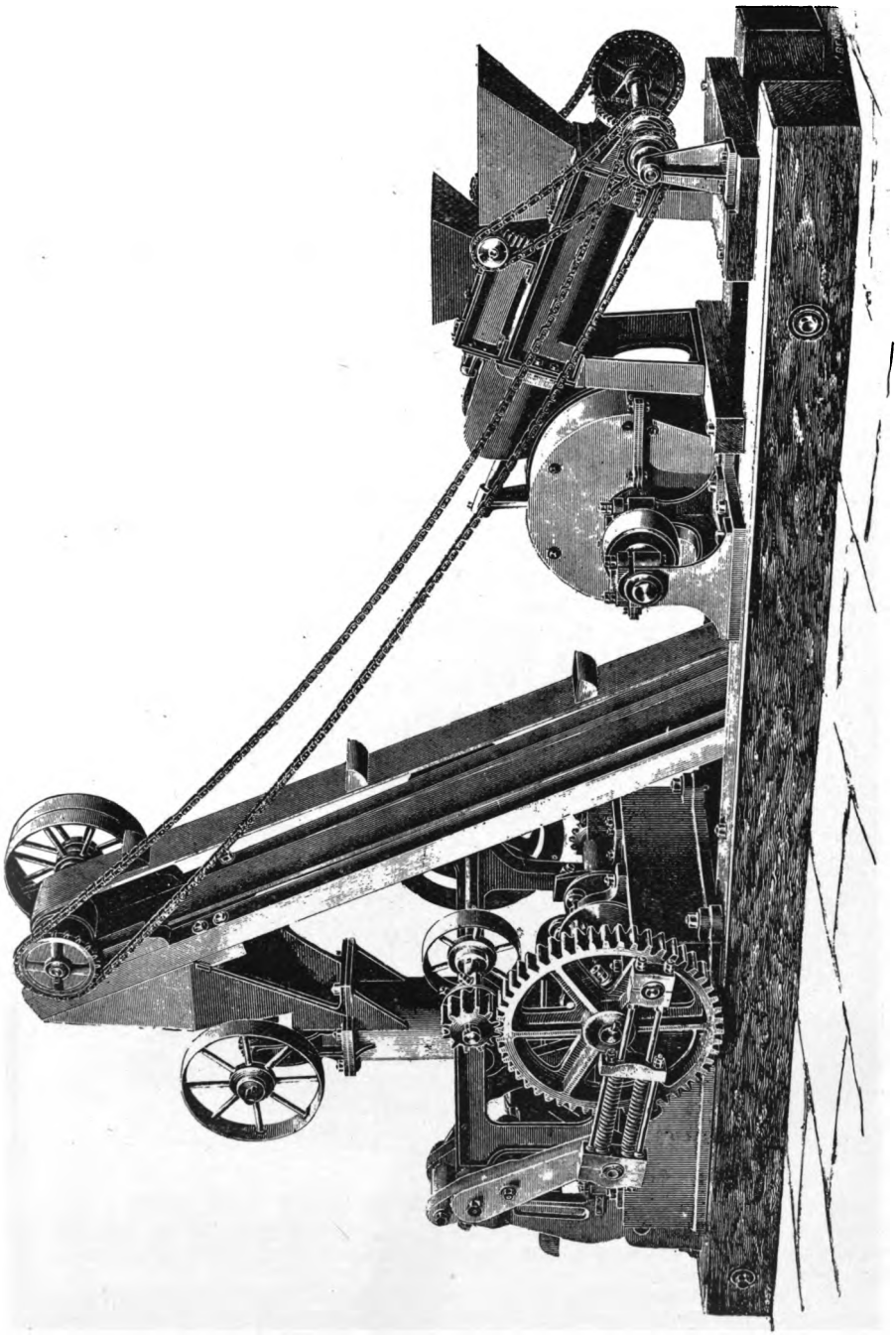


Fig. 6153.

The small coal and binding ingredients are fed into the mixing machine, and the proportions of these can be varied by change wheels to any extent desired. The materials then pass to the disintegrator where they are pulverised and further incorporated The elevators convey the materials to a vertical heater where they are projected by revolving blades to the pug mill. Here they are again mixed and passed forward into the mould plate in measured quantities, and are finally submitted to a pressure of about 2 tons per square inch, applied simultaneously to both sides of the briquette. Great solidity and tenacity is obtained by this process as well as an appreciable saving in the quantity of pitch or other agglomerate required to ensure complete cohesion.

As will be seen, all the operations are carried out automatically and any of the numerous agglomerating materials may be used which, for various reasons, find favour in different localities. Foremost amongst these is pitch ; but good briquettes are made which contain 7 to 10 per cent of lime. Other mixtures are 1 to 1½ per cent. (by weight) of starch—7 per cent. of fire clay—2 to 6 per cent of blue lias lime and 2 to 3 per cent of farina, &c. In some countries where molasses has little commercial value, about 1½ per cent. is found to be a good binding ingredient for coal ; with larger proportions of molasses useful briquettes have been made from sugar mill refuse commonly called "megass" or spent cane after the sugar has been extracted.

The quantities referred to in the following table are those the machinery is capable of making in 10 to 12 hours.

The driving power required is given, approximately, as a guide in estimating what should be provided ; and it will be well to bear in mind that the capacity of the boiler should be about 15 per cent in excess of that requisite for the engine alone.

PRICES OF BRIQUETTE MAKING PLANT, Fig. 6153.

Capacity .. .. .. tons per day	5	10	25	50	100
Price of plant	£340	£415	£865	£1380	£2100
Approximate nominal H.P. required ..	2½	3½	8	14	20

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

DISINTEGRATORS.

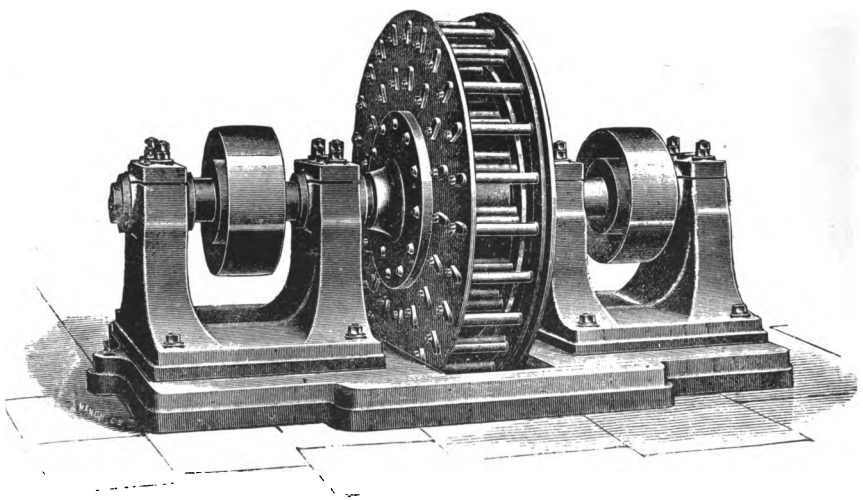


Fig. 6154.

Fig. 6154 represents an improved type of these machines, so well known for their efficiency in pulverising wet or dry mineral, animal and vegetable matter—many kinds of which cannot be ground by any other process.

The machine, as illustrated, has the outer case removed and shows one of the principal improvements. This consists in arranging the steel bars to be quite easily removed and renewed when worn, in lieu of the fixed bars formerly used.

The discs are of different diameters and are keyed to shafts which revolve at high speeds and in opposite directions. The effect on the materials operated on is, that they are violently thrown from bar to bar and very rapidly pulverised by the almost incalculable number of blows received in their passage through the machine. It will be evident that any moisture in the materials will be largely, if not entirely thrown off in the process of pulverisation ; also that an intimate mixture of different ingredients will be obtained, as referred to in the description of briquette plant, Fig. 6153.

The output given in the following table may be taken as the average obtained when pulverising coal, and may serve as a basis for estimating the approximate capacity of the machine for treating many other materials.

The power requisite to drive the machine efficiently, varies very widely according to the materials treated, but advice will be given on this subject as well as on the best arrangements for sieving and separating the pulverised matter, provided that samples are supplied or sufficient data is otherwise given.

Each machine is complete with massive bed plate, pedestals, bearings with large wearing surfaces, mild steel shafts, driving pulleys, wrought iron or mild steel discs with steel bars, iron external casing, &c.

PRICES OF DISINTEGRATORS, Fig. 6154.

Diameter of discs .. inches	18	30	36	39	45	48	54	60
Output per hour .. tons	1	1½	3	5	10	15	20	30
Price of machine	£45	£90	£124	£146	£158	£162	£208	£245

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

BOOT, SHOE, & LEATHER WORKING MACHINERY.

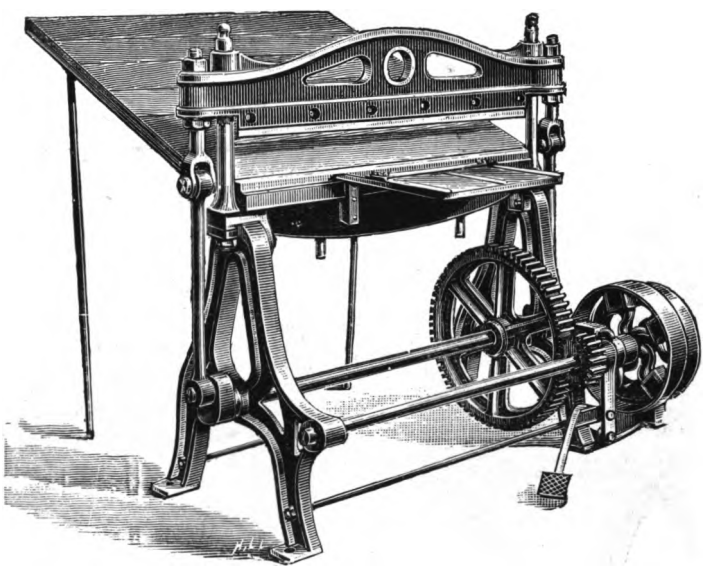


Fig. 6155.

BOOT AND SHOE MAKING MACHINES.—Great progress has been made during the last 10 years, in the production of special machines to aid—and in many cases supersede— manual labour in almost all branches of manufacture, but probably in none has the advance been more marked than in the industries connected with leather dressing and working. The almost endless variety of machines used in the different departments of boot making, precludes the mention of any but those in common use, it will however be found that those illustrated and described will suffice for many wants ; the others may be left for arrangement by correspondence.

Before proceeding with the description of the several machines, it may be well to point out that when cheap skilled labour is available, some of the processes may be carried out quite well—but never so neatly or cheaply—by hand, as by machine.

In other cases, where the quantity required is limited, or the amount of capital at disposal is insufficient for a complete plant, a commencement may be made with a few machines, leaving others to be added when needed.

If the machines about to be described do not seem to be entirely suitable for the work which the intending purchaser wishes to produce, his best course will be to send :—

1. Samples of the finished work and state the quantity required in a given time.
2. Information relative to the supply and cost of skilled labour.
3. The limit (if any) on the amount of capital at disposal for purchase of machinery.

If there is an entire absence of skilled labour the work can be done (as it has been done in many countries) by machines throughout, and by operatives who have had no previous training or experience.

The cost of packing the several machines for shipment and delivery f.o.b. will range from 5 to 10 per cent.

THE GUILLOTINE MACHINE Fig. 6155 cuts sole leathers into strips of the length and width required, and is also used for cutting leather driving belts and other straps.

The machine is complete with size gauge (not shown), and fixed knife, and is arranged to work by steam power or by treadle.

Length of knife .. .. inches	42	64
Price of machine	£20	£32

RANGING MACHINES for boot work similar to that last referred to but of smaller size, are made with guillotine knife and with circular cutter, gauge for sizes, &c.

Type of machine	Guillotine	Circular Cutter
Price of do. for hand power	£5	£7
Do. do. steam do.	£6	£8

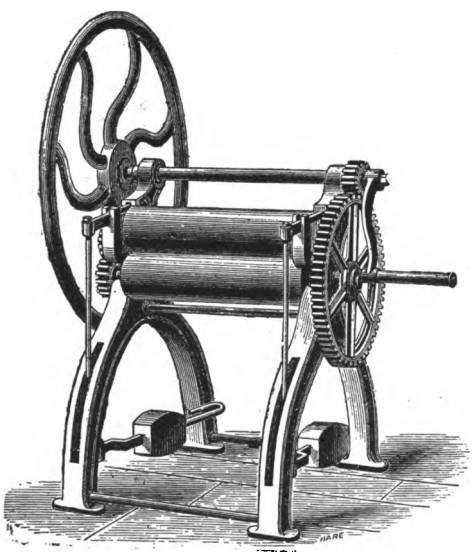


Fig. 6156.

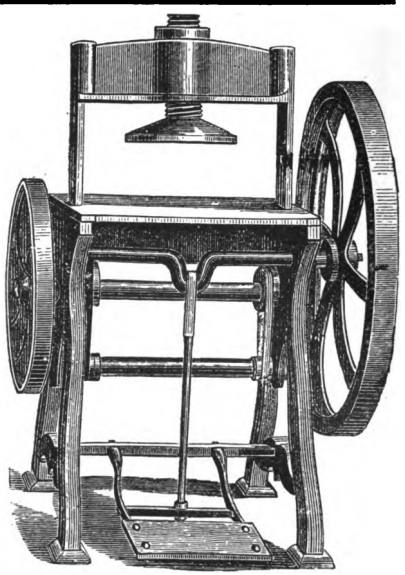


Fig. 6157.

LEATHER ROLLING MACHINES.—Fig. 6156 represents one of the numerous forms in which these machines are made and is a generally useful tool. The leather is compressed and solidified by being passed between the rolls, and the pressure is regulated by adjusting the position of the weights which are connected, as shown, with the lower roll.

PRICES OF LEATHER ROLLS, Fig. 6156.

Length of rolls .. .. .. inches	24	26	28	30
Price of machine for hand power ..	£16	£17	£20	£22
Ditto ditto steam do. ..	£17	£18	£21	£23

CUTTING PRESS with one adjustable head as shown in Fig. 6157 or with two or four heads. The table is truly planed and the machines are made to work by hand or are fitted with fast and loose pulley to be driven by belt.

PRICES OF CUTTING PRESSES, Fig. 6157.

Number of heads	One	Two	Four
Price of machine for hand power	£14	£26	£42
Ditto ditto steam do.	£15	£27	£44

CUTTING PRESS KNIVES, Fig. 6158.—As will be seen the knives illustrated are of the shapes required in boot and shoe manufacture; but the presses are used for other purposes and the cutting tools are made in any form desired. In all cases the steel used is of the highest quality and is carefully hardened and tempered.

Fig. 6158.

Types of knives	Men's	Women's	Boys'	Girls'	Heels
Sizes of do. .. .. .. No.	5 to 10	1 to 7	10 to 13	6 to 9	..
Price of do. .. .. .. each	7/6	6/-	5/6	4/9	3/-

PRICKING MACHINE, to perforate the fore parts and top pieces for rivetted work, with worm and wheel in phosphor bronze and complete with change wheels for three spaces of rivets, six prickers, treadle, &c.

Type of Machine	To fix on bench	With pedestal
Price of do.	£4 0 0	£5 0 0

SPLIT LIFT MACHINE for accurately forming the lining in heels.

Type of Machine	For hand	For power
Price of do.	£3 10 0	£4 0 0

SOLE LEATHER SPLITTING MACHINES reduce the leather to exactly equal thickness. The adjustments can be made with great accuracy and the parings to a large extent, are available for use.

To split in width .. .. .. inches	7	13	19	25
Price of machine for hand power ..	£7	£10	£11	£24
Ditto ditto steam do. ..	£8	£12	£13	£26

SKYVING MACHINE for paring leather, with adjustments for any angle, width or thickness desired.

Type of machine	Hand power	Steam power
Price of do.	£5 0 0	£6 0 0

Extra steel blades are charged 1/6 each.

BOOT SEWING MACHINES (see Fig. 6159 and description) sew with cotton, linen, silk or waxed thread up to 6 cord and are largely used for sewing boots and shoes and many other kinds of leather work.

Type of machine	With treadle	For power
Price of ditto	£10 10 0	£12 0 0
Extra for hard wax apparatus	£4 0 0	£4 0 0

LEATHER PUNCHING MACHINE with treadle .. .. £0 14 0.

Ditto **EYLETTING** ditto ditto .. .. £0 14 0.

Extra punches 3/- per dozen. Eylet dies or lace hook dies 2/6 per pair.

SOLE SEWING MACHINE capable of making 800 stitches per minute, entirely self-contained and complete with bobbins, duplicate parts, tools, &c.

Type of machine	With treadle	For power
Price of do.	£60 0 0	£62 10 0

HEEL BUILDING MACHINES with three pairs of moulds and a nailing horn, price .. .. £25 0 0.

Extra nailing horn, 35/- Top piece sprigging horn, 55/- Heel mould, hooped, 3/6.

BOOT AND SHOE MAKING FACTORY.—A convenient and economical arrangement of a factory, capable of turning out about 1200 pairs per week, and to be worked by operatives who have not hitherto been employed in that (or any other) branch of manufacture would require the equipment detailed in the following specification.

The number of sewing machines shown in this installation will turn out about equal quantities of men's and women's boots and shoes, and is in excess of what would be required if skilled artisans (such as abound in this and many other countries) were employed; this provision was made, in the factory under consideration, to leave a margin for training unskilled hands. If men's boots only are required, about half the number of sewing machines will suffice.

As already indicated, the number of work people for an output of about 200 pairs per day depends entirely on the quality of the labour—in England it would be (exclusive of office staff) as follows :—

	Men.	Females.	Youths.
Clicking department	6	..	4
Upper closing department	..	25	..
Bottom stuff cutting ,, ...	2	..	2
Lasting ,, ...	12	..	4
Heeling ,, ...	1	..	1
Finishing ,, ...	10	..	7
Stock room—socking, sizing, and packing ..	1	2	..
Total ..	32	27	18

SPECIFICATION OF PLANT FOR FACTORY.—This includes several machines not mentioned in the preceding pages and consists of:—

Ranging machine and spare cutters. Leather rolls, Fig. 6156.
Stiffener skyver and spare knives. Split lift machine and spare knives.
Sole splitting machine and spare knife. Pricking machine.
Double head cutting press as Fig 6157. Thirty-six press blocks and 6 iron bands.
Twenty-four insole and outsole knives for men, 24 for women.
Twenty-four ditto . ditto boys, 24 for girls.
Seven stiffener knives, 12 middle sole and 24 heel knives. Seventy-two pairs of iron lasts.
Double sewing machine bench with six upper closing machines and four wax thread machines, Fig. 6159, with shafting, bearings, pulleys, power transmitters, hand seam rubber, &c.
Upper skyving machine, 6 spare cutters and 2 emery wheels.
Twin eyeletting machine worked by treadle, spare punches and duplicates.
Punching machine, eyeletting machine, perforating machine, hooking machine and punches and dies for each.
Sole sewing machine with shafting, thread winder and waxing apparatus.
Thread, needles, hooks, wax, spare parts, &c., for upper closing and sole sewing machines.
Channelling machine—heel building machine with 3 attaching horns, one nailing horn and 3 pairs of moulds, 12 pairs extra moulds, 2 attaching horns, spare drivers, &c.
Heel breasting machine—sole levelling and heel trimming machines with extra cutters and spare parts.
Edge trimming machine with extra cutters, shields, &c.
Heel scouring machine with extra sand papering wheels, &c.
Heel burnishing machine—seat wheeling machine with extra wheels.
Twin edge setting machine with 24 spare edging tools.
Roll sand papering machine—buffing machine and extras for both.
Bottom finishing machine—staining and blacking machine with spare brushes, stains, &c.
A supply of finishing lasts—12 single boot racks.

The cost of plant and materials to the foregoing specification is about .. £700.
If with steam engine and boiler of ample power .. .. £825.
,, gas engine .. .. £810.
,, oil ,, ... £875.

The cost of packing for shipment and delivery f.o.b. varies according to destination, &c., but will probably not exceed 5 to 10 per cent.

Arrangement of plant.—If buildings suitable for the proposed factory are not available and space can be afforded for carrying on all operations on the ground floor, the building (allowing for extension) would occupy an area of about 120 feet by 45 feet. These should be well lighted from the roof and be arranged as follows:

The sole leather and upper leather stores, the rooms for clickers, lasters, &c. would be on one side of a passage the other side being occupied by rooms appropriated to the machine and finishing departments. The space at the end of the passage affords good accommodation for storing finished goods, packing, offices, &c.

If proper information is afforded with regard to the buildings or land available for the factory for any given output, the local conditions, &c., the writer will be prepared to advise on the most convenient and economical arrangements.

Cost of buildings.—The cost of an iron building with partitions, lighting, &c., will probably be £800 to £1000.

A SMALLER FACTORY or, as suggested in the introductory remarks, one in which it is desired to employ more skilled labour and fewer machines, the undernamed may be omitted:

The machinery for ranging, sole splitting, upper skyving, eyeletting, heel building, sole levelling, some sewing machines and the accessories for each of these.

The cost of the plant would then be about .. .. £550 0 0.

This amount would, however, be materially reduced if mens' boots only are made, or if the machines for the high finish required for women's boots and shoes (as made in England, France, &c.) is unnecessary.

RIVETTED BOOT MAKING MACHINERY.—Very serviceable boots are produced by this system and its use rapidly increases, but reliable estimates of the cost of plant cannot be made without samples of the kind of work required, or accurate information thereon, the quantity to be produced in a given time, &c.

For purposes of general estimate it may however suffice to say that a really useful plant, all machines worked by the operatives, will probably cost about £150 or a little more or less according to the class of work in demand.

MACHINES FOR MAKING HARNESS, ACCOUTREMENTS, DRIVING STRAPS, &c.—Some of the machines referred to in the article on boot and shoe making plant are, with certain modifications, similar to those used for the production of the above-named work. Many well known varieties are in constant operation in Government factories, railway and other works in all parts of the world, those now referred to being amongst them.

GUILLOTINE MACHINES cut the leather to the widths required and to gauge, adjusted by hand wheel and screw. For illustration and prices see Fig. 6155.

TRAVELLING KNIFE CUTTER.—The machine consists of a pair of standards supporting a planed iron table with a beam under which the leather is secured. The traversing knife is moved by suitable gear, the stroke is 6 ft. and it is carried in a planed slot in the beam. The action is very rapid and the thickest leather is cut at one stroke.

The price of the machine with appliances for adjusting the width of cut, and three extra knives is £25 0 0

ECCENTRIC CUTTING PRESSES.—For small work machines with one or more heads, of the type Fig. 6157, answer every purpose, but the undernamed machines are preferred for large work.

FOUR PILLAR ECCENTRIC CUTTING PRESSES.—The table is planed and the eccentrics give motion to four vertical rods working through bearings in the top and bottom of the standards.

The height of the platen is adjusted by a hand wheel and screw and the construction throughout ensures solidity and evenness of cut; the two smaller sizes are worked quite well by treadle and sizes exceeding 33 in. are made if required.

Dimensions of press .. .. inches	20	25	33
Price ditto with treadle	£20	£22	£30
Ditto ditto for steam power	£22	£24	£33

LEATHER SEWING MACHINES of the type Fig. 6159 sew with cotton, linen, silk or waxed thread and the following brief descriptions of these invaluable labour saving machines, indicate the purposes for which each type is generally used; the prices will be found in the following table under the corresponding letters (**A** to **F**).

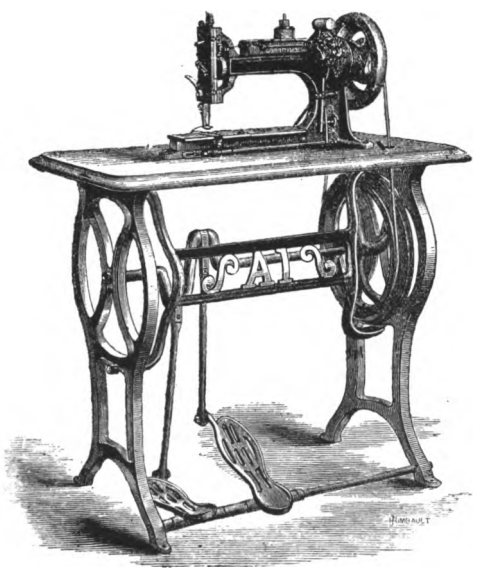


Fig. 6159.

The machines A and **B** sew leather up to ⅜ inch thick and are largely used in making boots and shoes, military and naval accoutrements, harness, light saddle, carriage builders and for other work.

The presser feet are made to suit the class of work the machine will have to do; the feed apparatus is arranged for the top and bottom feeders to work in unison and effectually prevent either piece of leather from getting out of position.

Special feeders and accessories are provided for binding rugs, horsecloths, &c., and the gauge can be adjusted to turn the widest binding equally on both sides, or unequally, either top or bottom.

The machines C and **D** differ in arrangement from those last referred to, and are specially adapted for sewing heavy harness and carriage builders fittings, traces, &c.

The machine E is more powerful than type **D** and, to a large extent, has superseded it. This machine sews a single thickness of harness leather, or any number of them up to about $\frac{7}{8}$ inch thick, and uses a wide range of sizes of thread (from 3 cord No. 18 to 10 cord) without adjustment. The length of stitch can be regulated from 3 to 16 to the inch and the tightness of sewing is accurately adjusted by a single screw. The needle thread may be used dry, passed through liquid wax, or passed through melted shoemakers' wax, and no holes need threading excepting the eye of the needle. The wax is heated by gas or petroleum oil, as ordered.

The machine F is specially designed and constructed for sewing joints, or double or treble driving belts, and to work at any speed up to about 200 stitches per minute. The waxing appliances are arranged to thoroughly saturate the thread, and the tension comes into operation after the thread has been waxed. The machines may be driven by treadle or power.

Hard waxing apparatus.—This is fixed below the shuttle race and the wax is melted by steam from a small boiler provided for the purpose. The flow of wax to the cup into which the needle dips, after the thread has passed the eye of the needle, is regulated by a screw, so that every stitch carries its proper quantity of wax and entirely fills the holes in the leather.

The importance of this simple and ingenious invention is now generally recognized and it is very largely used.

PRICES OF LEATHER SEWING MACHINES, A TO F.

Reference to description ..	A	B	C	D	E	F
Price of sewing machine ..	£12	£14	£18	£21	£27	£60
,, hard wax apparatus ..	£4	£4	£4	£4	£4	..

COTTON or **CANVAS BELT SEWING MACHINES** are made of the types **G** and **H**, which are similar to **E** and **F** but with the modifications necessary for sewing cotton, canvas, &c. instead of leather, at speeds varying with the thickness of belt, from 150 stitches per minute when worked by treadle, to 200 or 300 when driven by power.

The **G** size machine sews belts up to $\frac{1}{2}$ in thick and 8 to 10 in. wide; the **H** size sews the heaviest sections and up to the centre line of belts 30 in. wide. If a number of machines are used it may be convenient to range them on a bench, whilst in other cases machines complete with iron framework and stand, will be preferred.

PRICES OF COTTON BELT SEWING MACHINES.

Size of machine	G	H
Price of do to fix on bench	£20	£50
Ditto do. to work by power	£22	£52
Ditto power transmitter	£1	£2

LINK AND WASHER CUTTING MACHINE, mounted on an independent iron frame and provided with all appliances for forming the links for leather chain belts, punching leather washers, &c.

Type of machine	With treadle	For power
Price of do.	£16 0 0	£17 0 0
Extra cutters and dies per set	£1 10 0	£1 10 0

COUNTERSINKING MACHINE, to recess the outer links of leather chain belts £2.
Ditto ditto with stand and treadle .. .. .. £4.

RIVETS AND WASHERS for chain belting, price per cwt. from 35/- to 55/-.

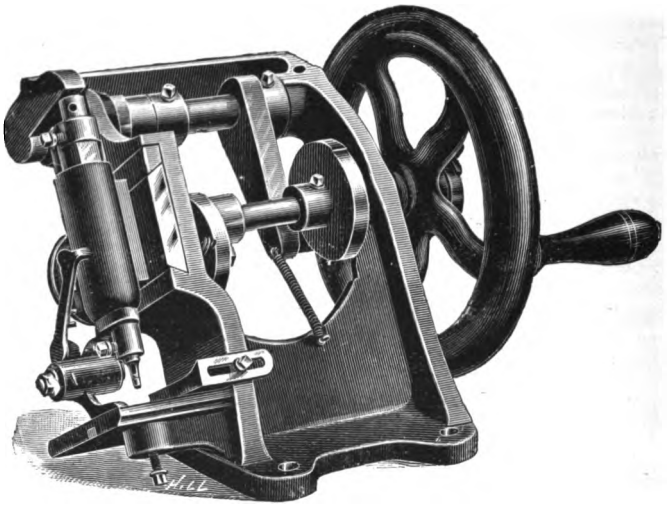


Fig. 6160.

HOSE PIPE AND STRAP PUNCHING MACHINE, Fig. 6160, with adjustable guide to punch holes in driving or other straps, and to punch simultaneously both edges of hose pipe leathers.

The machine is fixed on a bench and, worked by hand power, will punch about 200 holes per minute, or when worked by power 300 to 400 holes.

Type of machine	to work by hand	By power
Price of machine	£11 0 0	£12 0 0

LEATHER DRESSING MACHINERY.—Want of space precludes more than a bare mention of this branch of industry in which ingenious mechanical appliances have done so much to increase the output of highly finished products and reduce the cost of the manual labour employed in the different processes.

Full information will, however, be furnished on receipt of sufficient details more especially with regard to the kind and quantity of leather to be treated in a given time, the finish required, &c , with, or without specimens showing the conditions it is desired should be fulfilled.

PRINTING AND PRINTERS' MACHINERY.

A large volume would barely suffice to illustrate and adequately describe the numerous appliances used in this varied and highly important industry, and space admits of only a bare mention of the Hoe, Marinoni, and other types of "perfecting" and rapid working machines commonly employed in printing (with or without illustrations), the daily and weekly papers of large circulation in all parts of the world, or of machines for Lithographing, Hot and Cold Rolling, Perforating, &c. But the following information is given in the hope that it may again be useful, and lead to requests for details with reference to printers' plant specially required, accompanied by proper explanations regarding the conditions to be fulfilled.

A SMALL PRINTING OFFICE PLANT suitable for general work and for printing a small newspaper comprises :—

A Wharfedale Printing Machine Fig. 6167, with or without fliers for automatic delivery, for printing sheets within the undernamed limits of size and to turn out about 1200 (or more) printed on one side, per hour. Allowing for changes from outside to inside, this is equivalent to about 500 copies per hour, printed both sides.

Machines of this construction are made to take in sheets varying in size from 17 by 11 ins. to 74 by 50 ins., but one or other of the sizes mentioned in the following table usually suffices for work of the kind now referred to.

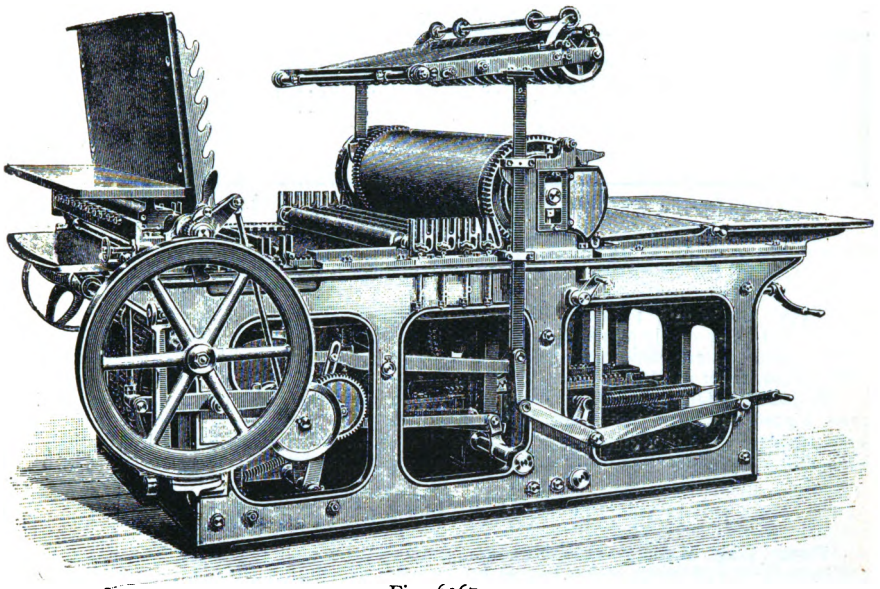


Fig. 6167.

The machines are complete with double roller inking motion, arrangements which prevent the cylinder checking at the wrong time, and facilities for rapid feeding. The fliers are arranged to be easily moved clear of the cylinder, so that "making up" can be done on any part of it, and each machine is provided with two sets of roller stocks, one being covered with composition, locking bars for chase, driving pulley, screw keys, &c.

PRICES FOR WHARFEDALE PRINTING MACHINES. FIG. 6167.

To take in sheets, size in ... ... inches	30 by 20	35 by 22½	40 by 25
Price of machine with flier	£155	£178	£217
Ditto without flier	£140	£163	£199
Ditto with geared inking rollers extra	£11	£12	£13
Ditto to print two colours, with flier...	£215	£255	£300
Ditto with geared inking rollers, extra	£22	£24	£26

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

Platen Printing Machine, foolscap folio (platen 15 by 9¾ in.) size, completely balanced, and suitable for high-class work.

The chase is locked or released by a lever motion, the ink cylinder can be thrown out of gear and two colours may be worked without emptying the ink box. The machine is complete with screws for adjusting the frisket fingers, the impression &c., and with two chases, two sets of roller stocks, roller mould, driving pulley for power or treadle, screw keys, &c.

The price of the machine is £50 0 0

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

A Small Hand Press for taking proofs, costs from £10 0 0 to £15 0 0

A Galley Press, for proving the columns of matter for a newspaper, costs about £14 0 0.

Guillotine Machines vary widely in design and size, but a hand power machine, to cut 20 or 26 in will probably suffice for most small printing establishments.

PRICES OF GUILLOTINE MACHINES.

To cut any length up to ... ... inches	20	26	32	38
Price of machine to work by hand	£35	£45	£55	£75
Ditto ditto by power	£39	£49	£60	£80
Extra for side guides	£2	£2	£2	£4

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

PRICES OF PAGING AND NUMBERING MACHINES.

Number of figures printed	4	5	6
Price of hand worked machine	£7	£10	£11
Ditto set of extra figure wheels	£4	£5	£6
Ditto treadle worked machine	——	——	£33
Ditto set of extra figure wheels	——	——	£7

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

Shaftings, Bearings, Pulleys, &c., for driving a Wharfedale and a platen machine under ordinary conditions, should cost from .. .. .. £20 0 0 to £25 0 0.

A Gas or Oil Engine to drive the last named machinery, and allowing a fair margin of power for extension, will cost from .. .. £70 0 0 to £90 0 0.

Type, Materials, Printers' Tools, &c.—The outlay on these may reach almost any amount, but a fair supply of materials including type, chases, brass rule, shooting sticks, mallet, planer, lead cutter, imposing surface, composing sticks, composition kettle, stirrer and composition, roller moulds, blankets, &c., may be procured for £200 0 0 to £250 0 0.

A Jobbing Office Plant, including a Demy folio (platen 18 by 12 ins), Albion printing press, a good supply of type, leads, brass rule, rule shears, cast-iron chases, quoins, shooting stick, planer, demy-folio, quarto, and octavo galleys, composing stick, &c. Also a supply of black and red ink, ink slab, roller and frame, lye preparation, brush, &c., costs about £55 0 0.

PAPER BAG MACHINERY.

Paper Bag Making Machines, are arranged to uncoil the paper from a revolving continuous roll, and make square bottom bags which are delivered dry and ready for use at the other end. Paper of any thickness may be used, and, by merely altering the change wheels, any machine will produce bags of twelve different sizes. All operations are performed automatically, and, if desired, a simple form of printing machine is added, which, at a cost of less than one penny per 1000, prints the bags before they are delivered into the boxes for removal and packing.

After the paper has been uncoiled, cut to the proper size and shape, folded on the 'former' and pasted, it is carried by an endless band over a revolving drying cylinder which is heated by steam, gas, or petroleum; this dries the bag and it passes on to the printing machine or into the collecting box, as the case may be.

The machines are made in three sizes as follows:—

MACHINE A makes bags varying in length, from 5 in. (127 m/m) to 10 in. (254 m/m), and in width, 3¾ in. (95 m/m) to 6¾ in. (150 m/m) and is capable of turning out 7000 finished bags per hour. The floor space occupied is 15 ft. (4 m 55) in length, and 4 ft. 6 in. (1 m 35) in width. One Horse Power is ample for driving, and the weight is about 2¾ tons.

MACHINE B makes bags varying in length, 9¼ in. (235 m/m) to 14½ in. (370 m/m), and in width, 6¼ in. (160 m/m) to 10¾ in. (273 m/m), and is capable of turning out 4000 finished bags per hour. The floor space occupied is 18 ft. (5 m 50) in length, and 4 ft. 6 in. (1 m 35) in width. The power required is one H.P., and the weight is about 3 tons.

MACHINE C makes satchel shaped bags, varying in length from 5 in. (127 m/m) to 20 in (508 m/m) and in width, 2½ in. (63 m/m) to 7½ in. (190 m/m), and is capable of turning out 10,000 finished bags per hour. The floor space occupied is 21 ft. (6 m 40) in length, and 4 ft. 8 in. (1 m 40) in width, and the weight is about 2 tons.

The average cost of working the A and B machines, in England, including labour, motive power, oil and wipings, interest on capital, and all usual charges is about 13¼ pence per 1000 bags. This is usually equivalent to about one shilling per cwt (112 lbs.) of finished bags.

The cost per 1000 of bags produced by the machine C is slightly less than last stated.

The price of the machine A B or C is £350 0 0

The price of the automatic printing machine £250 0 0

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

PAPER BAG MAKING PLANT.—A useful equipment for a small factory consists of one machine A and B with main driving shaft, bearings, pulleys, belts, &c., gas engine or steam engine and boiler for working the machines, with fittings and connections to the revolving drying cylinder.

The approximate cost of such a plant is £800 0 0

The weight and measurement will equal about 15 tons.

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

SOAP MAKING PLANT,

To work by gravitation and to produce 20 tons of white curd soap per week comprises :—

The necessary wrought iron soap pans complete with all attachments, for open and dry steam boiling, running off pipes, &c.

Wrought iron oil tanks, with steam coils and fittings, set of crutching machines, with steam engine and fittings, pumping engine and fittings for leys. Oil drain tank, iron store ley tanks and fittings, soap frames, slabbing machines, bar cutting machines, tablet stamping machine, hand pails, ladles and skimmers.

Cornish boiler, with all furnace, steam and feed water fittings, feed pump, connecting pipes, valves, &c.

The cost of this plant is about £3000

A Plant to produce 10 tons of white curd soap per week, but similar in arrangement to that referred to above, costs £1360 0 0

A Plant to Produce 5 tons of white curd soap per week, which is about the smallest that will work with satisfactory results, costs £450 0 0

The cost of packing for shipment and delivery f.o.b. is about 5 per cent

BRICKMAKING MACHINERY.

Illustrations and descriptions of machines to produce bricks by the dry, semi-plastic and plastic processes would occupy more space than can be devoted to this subject ; the present remarks must therefore be limited to a description of machines in general use for making bricks, tiles, pipes, &c. from plastic clays and a brief reference to fire brick making plant. Large installations and especially those in which one or other of the modern (patent) kilns are adopted require special consideration. So also do the machines for working dry or semi-plastic clays, Full information should be given with reference to the materials available or, (if possible) samples of them and of the articles to be produced. The pug mill mixes and reduces most kinds of clay to a sufficiently plastic condition to flow through the brick forming dies, as shown in Figs. 6170 and 6171. In some cases, however, grinding by edge runners of the mortar pan type, or by clay rolls which reduce hard lumps, pulverise stones &c., is desirable, and this effects a large saving by using much good material which would, otherwise, be wasted, beside adding considerably to the efficiency of the pug mill and the quality of the finished products.

PUG MILLS.—The engravings Figs. 6170 and 6171 represent the vertical mill so largely used in all countries and worked respectively by steam and horse power. The vertical casing or cylinder is bell mouthed at the top for facility in feeding, and is made in halves for convenience in transport, erection, examination &c. Outlet mouth pieces are provided on each side and the doors are adjustable for the purpose of pugging the clay more or less completely, as required. A wrought iron vertical shaft carries the pugging knives and is supported at the top by a stretcher and bearing.

The power driven pug mills are arranged as above described, a bracket being provided to support the bearing for the horizontal pinion shaft and are complete with pedestal and gun metal bearings for the outer end, pulley, &c., as indicated in Fig. 6170.

Horse power pug mills are as above described but fitted to take a pole and yoke (shown in Fig. 6168) or a pair of these if required.

PRICES OF VERTICAL PUG MILLS.

Diameter of cylinder ... ... inches	21	21	24
Height of do. ... ... ,,	42	48	48
Price of mill for steam power	£24	£25	£27
Ditto ditto horse do.	£14	£16	£18

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

PORTABLE HORIZONTAL PUG MILL.—The cylinder is made in halves and is mounted on two under carriages with plain wheels for a road or flanged wheels for a tram line.

The cylinder is provided with a feeding hopper and with adjustable slide to the outlet to regulate the degree of mixture. The pugging knives are secured to a strong wrought iron shaft which is rotated by bevil gear and belt on the pinion shaft.

These mills are specially adapted for preparing the "puddle" used in various public works such as reservoir banks, &c., or for other purposes requiring thoroughly mixed materials, and any desired degree of plasticity.

PRICES OF HORIZONTAL PUG MILLS.

Diameter of cylinder ... ... inches	18	21½	24
Price of machine...	£25	£30	£40

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

HORIZONTAL PUG MILL AND CRUSHING ROLLS.—The mill is fixed on a strong foundation plate and is complete with all driving gear. A set of multiple crushing rolls, or a pair roll mill, similar to that described further on, is fixed above the pugging cylinder into which the crushed clay is delivered direct from the rolls.

The price of the machine with one pair of crushing rolls, self-acting friction clutches, fast and loose pulley and all accessories is... ... ... £85 0 0.

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

CLAY CRUSHING MACHINES.—These may be of the roll or edge runner construction and, as mentioned in the foregoing remarks (see "Brickmaking Machinery") crushing machines are often useful, and sometimes absolutely necessary, for economically working with clay which contains hard lumps, or is interspersed with stones or other substances which (unless they are crushed and thoroughly amalgamated) would interfere, firstly with the pugging process and subsequently, with the finished products.

Crushing rolls are made of many sizes and proportions other than those referred to in the following tables. These deal, however, with clays varying widely in composition and consist of a pair of strong side frames which are fixed to a foundation plate and carry the roll spindles and all driving gear. The driving pinions have self-acting friction appliances; the rolls are made of special metal and fitted with scrapers, &c.

MULTIPLE ROLL CRUSHING MILL.—This is an adaptation, for clay crushing, of the "gradual reduction" system referred to in the articles on "Roller Milling" and 'Oil Milling" machinery.

The upper rolls have projections which rapidly reduce the mass of clay before it is passed between the smooth final pair of rolls.

PRICES OF MULTIPLE ROLL CRUSHING MILLS.

Diameter of rolls .. .. .. inches	16	18	22	24
Length of do. .. .. .. ,,	20	20	24	30
Driving power required H. P.	4	5	8	10
Price of machine	£65	£90	£135	£175

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

CLAY CRUSHING ROLLS with two smooth rollers, one type of which is illustrated by Fig 6168, answer every purpose for treating most kinds of clay and are successfully used under widely differing conditions.

The machines are fitted with pulleys to drive by belt and the engine power required will be found in the following table.

PRICES OF BELT DRIVEN CLAY CRUSHING ROLLS.

Diameter of rolls ... ... inches	16	20	24
Length of do. ... ... ,,	20	20	24
Driving power required ... ... H.P.	2	3	4
Price of machine	£45	£55	£80

The cost of packing for shipment and delivery f o.b. is 5 per cent.

HORSE POWER CLAY CRUSHING ROLLS.—This compact machinery is arranged as shown in Fig. 6168 and the proportions and equipment are as follows:—

The rolls are 18 in. diameter by 20 in. long and the mill is complete with horse power driving gear, pole socket for one or two horses, shafting, couplings, &c.

The price of this machinery is £48 0 0

The cost of packing for shipment and delivery f.o b. is 5 per cent

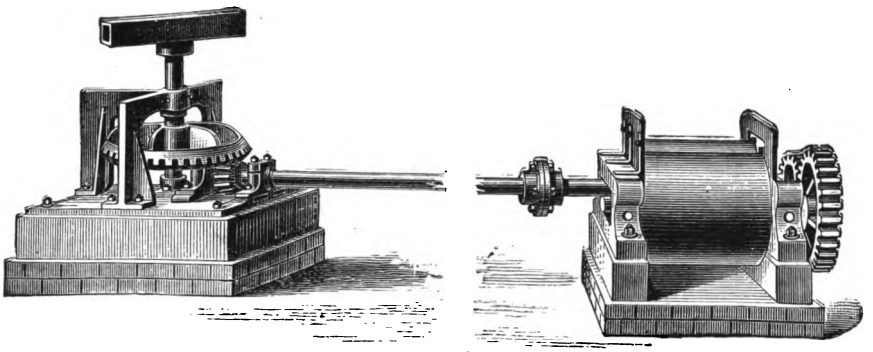


Fig. 6168.

EDGE RUNNER MILLS are similar in construction to the mortar mills illustrated and described in Section V., but they are adapted for either wet or dry grinding as required and are usually driven by overhead gear.

The pans vary in depth from 12 to 15 in. and should make from 18 to 22 revolutions per minute. The wearing tracks consist of special hard iron segments which are easily renewed, and the machines are complete with cross shaft and bearings, fast and loose pulleys, sweepers, and all necessary accessories.

For wet grinding the bottom of the pan is solid.

For dry grinding the bottom is perforated with holes through which the pulverized materials escape, and are automatically swept from the collecting pan to the elevators which convey them to the sifter, mixer, or pug mill.

PRICES OF EDGE RUNNER MILLS FOR WET GRINDING.

Diameter of pan ... ... feet	6	7	8½
Dimensions of rolls ... ... inches	36 by 12	50 by 12	64 by 15
Weight of do. ... ... cwts. each	16	29	45
Price of mill	£90	£135	£170
Approximate weight ... ... tons	5½	9½	12

PRICES OF EDGE RUNNER MILLS FOR DRY GRINDING.

Diameter of pan ... ... feet	6	7	8½
Dimensions of rolls ... ... inches	36 by 12	50 by 12	64 by 15
Weight of do. ... ... cwts. each	16	29	45
Price of mill	£100	£150	£185
Approximate weight .. .. tons	6	10½	13

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

ROLL CRUSHING, PUGGING, AND BRICKMAKING MACHINE.—The engraving Fig. 6169 represents a machine combining the appliances for crushing—the advantages of which have already been mentioned—with pug mill and brickmaking and is capable of producing 10 to 12,000 bricks per day with a minimum cost for manual labour. A pair of crushing rolls are fixed on the top of the horizontal pug mill from which the clay is delivered in a continuous stream, through dies of improved design, to the receiving table where the bricks are cut to any desired thickness, and true in shape. The machine is complete with dies to make plain bricks but any other shape can be made by simply changing the linings of the die. It will be seen that no manual labour is required excepting that necessary for charging the clay into the crushing roll hopper (not shown in the engraving) and cutting off the bricks.

The cutting off table (not shown in the engraving but included in the price) is of the side delivery type.

Travelling table.—This valuable invention greatly reduces waste of material, as well as the labour in cutting and carrying, and it can be fitted to the machine in place of the side delivery, at the undernamed slight extra cost.

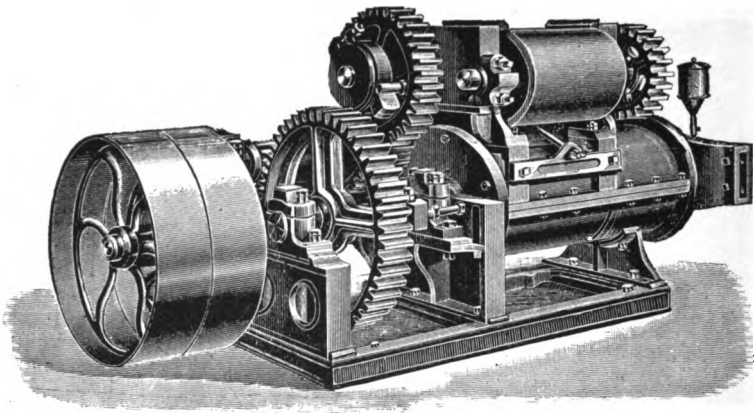


Fig. 6169.

Hoisting gear.—Another economy is effected by the use of incline gear (see Figs. 6043 and 6044 Section VI.) for drawing the truck to the level required for delivering the clay to the crushing rolls.

The appliances for this purpose consist of a winding drum with a driving gear, flexible wire rope or crane chain, and brake and lever for controlling the descent of the truck.

The price of the machine as Fig. 6169 is £100 0 0
If with travelling table £110 0 0
Hoisting drum on machine extra £15 0 0
The cost of packing for shipment and delivery f.o.b. is 5 per cent.

END TIPPING CLAY TRUCKS of one cubic yard capacity strongly constructed of timber and suitable for the incline to the clay hopper. Price each £7 10 0.

Steel tipping trucks—narrow gauge railway &c. see "Mining Machinery" Sec. VI. A.

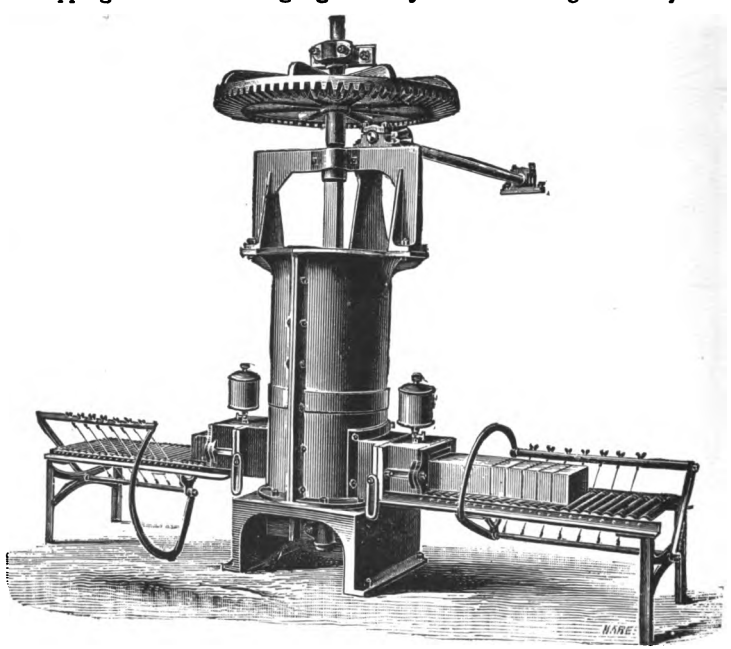


Fig. 6170.

THE STEAM DRIVEN PUGGING AND BRICKMAKING MACHINE. Fig. 6170 driven by an engine or other motor of about 4 horse power, is capable of producing about 10000 bricks per day.

The dies are self-lubricating and the prepared clay issues from the opposite outlets of the pug mill, the cutting tables are worked alternately or otherwise, as required.

HORSE POWER PUGGING AND BRICKMAKING MACHINE is precisely similar to that last described, excepting that the pug mill is worked as indicated in Fig. 6171 but with two poles and yoke to each. The output of the machine is about 6000 bricks per day.

PRICES OF BRICKMAKING MACHINE TYPE. 6170.

Mode of driving	Steam power.	Horse power.
Price of machine	£60	£50

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

DIE LININGS.—Each machine is provided with dies for producing rectangular bricks, but fancy or irregular forms can be made by any of the machines, by simply changing the linings of the dies.

The prices for linings of patterns usually required varies from 15/- to 25/- or are made to special drawings, with but slight increase in cost.

CLOTH FOR LINING BRICK DIES price per yard £0 3 0

DIRECT ACTING STEAM PIPE MAKING MACHINE.—The principal features in this valuable invention are :

The pipe and socket are formed at one operation.

The clay cylinder has an expanding mouthpiece which admits of pipes being made of any diameter.

Pipes may be made of all sizes up to 24 inches diameter and three pipes of the smaller sizes are made simultaneously.

Provision is made for the free egress of air and for producing pipes of superior quality and finish.

The machine occupies little space, is extremely simple in action and is easily worked. Each machine has a steam cylinder 24 in. diameter and the prices include seven metallic socketting dies for pipes from 3 to 18 in. diameter.

PRICES OF STEAM DIRECT ACTING PIPE MAKING MACHINE.

Diameter of pipes produced ... ... inches	3 to 18	21	24
Price of machine	£265	£290	£315

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

GLAZED PIPE MAKING.—The machine is largely used for this purpose and full instructions will be given to purchasers, for the construction and use of the glazing kilns.

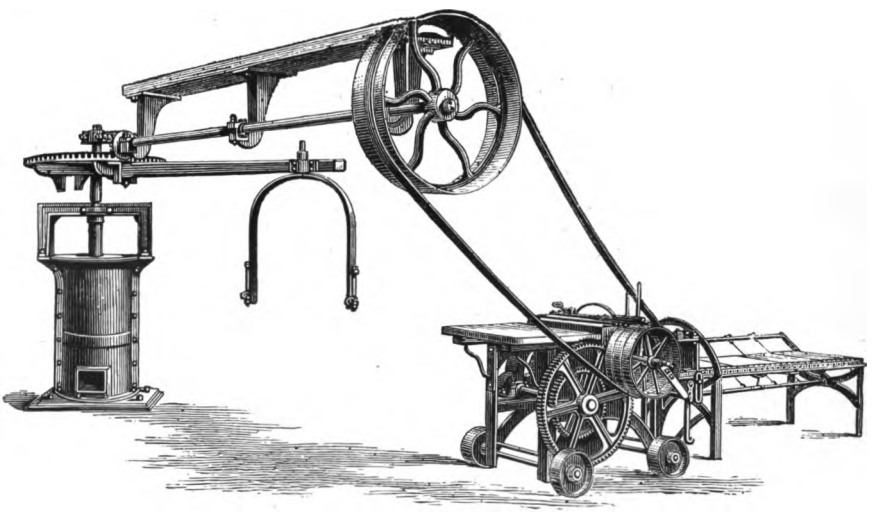


Fig. 6171.

PIPE, TILE, AND BRICKMAKING MACHINE.—The belt driven machine Fig. 6171 makes perforated, hollow or solid bricks, flooring or other tiles, and pipes of all sizes up to 12 in. diameter and is capable of turning out 5,000 bricks or 12,000 pipes per day when attended by one man.

The clay chamber is fitted with a piston or "plunger" which projects the clay forward and stops automatically when it reaches the end of the stroke; the return stroke is made at double speed by sliding the belt on the outer pulley.

The cutting table receives the clay as it issues from the machine and the wires are easily adjusted to cut the lengths or thicknesses desired; the products are carried away (usually) by boys.

DOUBLE ACTION PIPE AND TILE MACHINES.—By a modification of the construction indicated in fig. 6171 the machine is made to deliver at either or both ends, but one end is frequently used for removing extraneous matter, such as stones, roots etc. called "screenings," and the other for making pipes, tiles or bricks.

The following prices do not include the pug mill or other accessories, but these will be found elsewhere.

The output of the respective machines refers to 2 inch pipes; that of bricks is rather less than half and other goods in proportion.

PRICE OF HAND POWER MACHINES TYPE Fig. 6171.

Mode of driving	By hand.		By belt	
Output of pipes per day	8000	12000	12000	20000
Price of single acting machine	£25	£41	...	...
,, double acting ,, ...	...	...	£39	£52

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

Expanding mouthpiece for making pipes over 6 in. diam. £1 15 0
Dies for 9 and 12 inch pipes each £2 15 0
Upending table for placing pipes on carrying off board £6 10 0
Pipe socketting machine for forming the sockets on ends of pipes ... £14 0 0
Moulds, plungers and mandrels for pipes are made at the following prices:

Diameter of pipes inches	2½	3	4	5	6	8	9
Price of moulds, &c. ...	£5 0 0	£5 0 0	£5 10 0	£6 10 0	£7 10 0	£9 10 0	£10 10 0

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

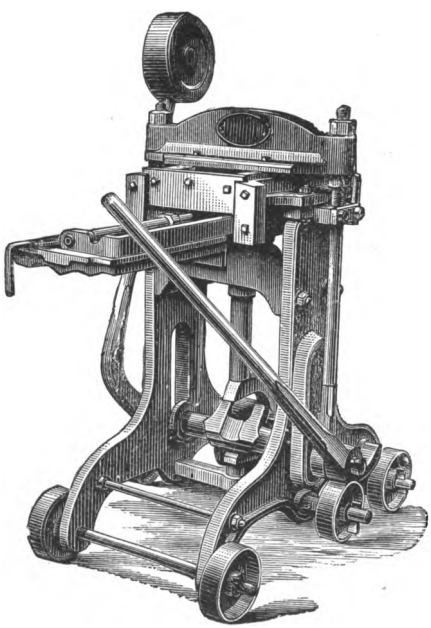


Fig. 6172.

BRICK AND TILE PRESSES worked by hand power, usually answer every purpose for producing from the blanks, made by one or other of the machines referred to in the preceding pages, the endless variety of forms and impressed patterns required for decorative construction.

THE LEVER PRESS, Fig 6172 is a well designed machine and produces plain or any pattern of ornamental tiles, at a speed of several thousands per day.

The tile blank, having been allowed the time requisite to stiffen, is placed on the die and slid into the press. The pressure is then applied by the lever and the die withdrawn. This is turned over as shown in the engraving and the tile drops on a palette for removal without handling. The tiles are produced very quickly and are perfect in shape and finish. A further advantage is that the operative cannot possibly be injured when placing the blanks or taking away the pressed tile.

The price of the machine without dies is £15 10 0

SCREW OR CAM ACTION PRESSES are less rapid than the lever press, but if a sustained pressure is necessary, a combination of worm and wheel and screw, or a cam action, gives excellent results.

The prices of these machines range from ... ... £20 0 0 to £25 0 0

STEAM DRIVEN PRESSES.—Large installations which have a constant demand for certain kinds of tiles, embossed or fancy bricks &c., usually require one or more specially designed presses, and the writer has constructed such machines to work by direct steam or hydraulic pressure, or by gear to suit the conditions to be fulfilled.

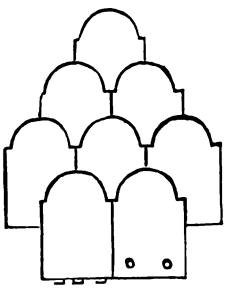


Fig. 6173.

Fig. 6174.

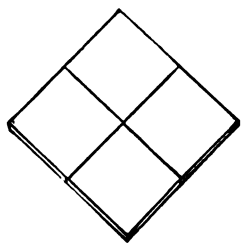


Fig. 6175.

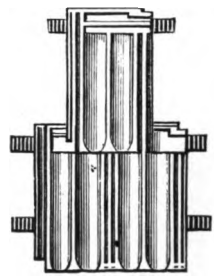


Fig. 6176.

DIES FOR TILE PRESSES.—Figs. 6173 to 6176 serve to illustrate some of the very numerous designs in common demand. Many others are made at about the same prices ; elaborate or special patterns are necessarily higher in cost.

PRICES OF DIES FOR TILE PRESSES.

Pattern of tile ... ... Fig. No.	6173	6174	6175	6176
Price of dies	£4	£4 10 0	£4 10 0	£5 10 0

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

FIRE BRICK MAKING.—The arrangement of machinery depends largely upon the materials used and the extent of the output and, unless the proprietors are sufficiently conversant with the details of the business to prepare an exact specification, their best course will be to state the maximum present and prospective demand, and send half a ton to a ton of the materials to be used. Samples will be made from these which will demonstrate in the most practical manner, the quality of the products, and the suitability of the machinery for making them.

Drawings are sent, in advance, showing the disposition of the machines and the preparations required for erection.

GLAZING.—If glazed pipes, brick etc. are to be used, drawings and full instructions will be supplied for the construction and use of the glazing kilns.

FIRE BRICK MAKING PLANT.—The following specification relates to machinery for making fire bricks from a mixture of clay shale, marl, or other materials, with a minimum admixture of water, and is adapted for turning out about 4000 fire bricks per day of 10 hours, or an equivalently larger number of common bricks, pipes or tiles. This output will be too limited for many fire brick works but is entirely suited to the conditions for which the plant was designed ; this was to supply the local demand for ordinary fire bricks, including those of neighbouring steel and iron works, where supplies cannot be obtained at a reasonable cost or in a reasonable time.

With the exception of feeding the edge runner mill, the whole of the operations are performed automatically, the only manual labour required being, one man at the mill, a boy at the mixer, and two boys at the brick making machine which delivers the bricks or other goods ready to carry away for drying, setting in kilns, burning, drawing and delivery.

The arrangement of plant admits of extensions being made, without interfering with the working of the existing machinery.

The machinery consists of:—

An overdriven edge runner clay crushing and tempering mill, 7 feet diameter, with perforated bottom and complete with fast and loose pulley, etc. This prepares the materials for the mixer, which is fed automatically by the elevator.

A set of elevators complete with a strong indiarubber belt, with elevator buckets and complete with bottom and top belt rollers, spindles and bearings lined with gun metal, driving pulley, shaft and bearings, elevator trough, straps, bolts, etc.

An improved horizontal mixing machine, with driving pulley and all accessories ready for fixing.

A triple roll brick, tile and pipe making machine with brick die, improved side delivery brick cutting table, fast and loose pulley, etc.

A complete set of driving gear, including bright turned shafting, pedestal with hard gun metal bearings, wall box, etc. for main shaft, and wrought iron split pulleys, bored, turned and fitted for driving each machine.

The price of this machinery is £365 0 0

The approximate weight is 14 tons and shipping measurement rather more.

About 15 nominal horse power is required to drive the machinery.

For prices of engines, etc., see "Prime Movers" Section I.

SECTIONAL BURNING AND DRYING KILNS.—Considerable economy is effected by using an improved form of kiln for burning bricks, fire bricks, pipes, roofing and other tiles, Gas retorts, crucibles etc., and for drying them by the waste gases which are entirely lost, when kilns of the ordinary type are used.

The kiln consists of a series of arched chambers connected by an overhead main flue, which conducts the heated gases to any of them.

Each chamber is capable of holding 15000 to 20000 bricks or the equivalent in bulk of other goods; the time occupied in burning, varies from 12 to 24 hours, according to the degree of hardness required, and the consumption of small coal ranges from about 1½ to 3 cwt per 1000 bricks, in proportion with their dimensions, the description of clay etc. After the heated gases have passed through the burning chamber, they are further utilized in the drying shed to dry the goods ready for the kiln.

The output from a six chambered kiln is about 120000 bricks per week; a two chambered kiln is the smallest that can be used, and this will deal with the output of the fire brick making plant last referred to.

Working drawings are supplied for the construction of the kilns and the cost of these and the whole of the ironwork, is from £40 to £50 per chamber.

The total cost of the kiln will probably be from £110 to £120 per chamber.

BREWERY PLANT.

BREWERY PLANT varies so widely in character and arrangement, according to the kind and quantity of beer to be produced in a given time, the number of brewings per week, the qualities of water, malt, etc., the amount of capacity available, and other conditions that, in the space now at disposal, it is impossible to illustrate and describe the numerous appliances suitable for use, under these most widely differing conditions.

General data might be given with reference to the cost of existing breweries but, owing to the variations above alluded to, it is scarcely probable that such data would convey information which could be usefully applied in connection with the contemplated undertaking.

For these reasons reliable estimates of cost cannot be made, or the arrangement of plant determined, without accurate information with regard to the conditions to be fulfilled and on the points above alluded to, together with plans of the proposed brewery.

These can however be made (on terms to be agreed) and sent with the estimates, if that should be desired.

ICE MAKING AND REFRIGERATION.

Amongst the systems of machinery in general use for making ice and for refrigerating, those best known are the Ammonia (N.H. 3) compression, Carbonic Anhydride (C.O. 2), Ether, Dry cold air systems, etc. All give good results under certain conditions and the decision as to which system shall be adopted is largely a question of convenience, climate, and relative cost of chemicals.

If, however, the largest yield in ice or in volume of refrigerated air at the lowest outlay for fuel and chemicals is sought, the decision must often be in favour of the Ammonia compression and brine system, one arrangement of which is illustrated by Fig. 6178.

Output and working expenses.—The quantity of ice produced is about 14 tons for each ton of coal consumed in continuous working and the costs of chemicals is quite trifling; such results are obtained by no other process and the comparison in regard to wear and tear is equally favourable.

In this as in many other industries, the larger the output the lower is the cost of labour per ton of ice made. As an example of this: an engine driver, stoker and labourer are required to work a 5 tons plant, whilst the same men with two more labourers easily work a 50 tons plant.

It follows therefore that, if the sale of ice at remunerative prices can be combined with refrigeration and a large plant employed, the cost of cold storage is insignificant.

Temperatures.—Attention is directed to the self-evident fact that the yield from machinery of given capacity is largely affected by the temperatures of air and water and due provision must be made for these. For the present purpose the normal temperatures in England have been adopted in preparing the tables of average production, prices of machinery etc.

Cost of plant.—If estimates of cost are desired, it will be evident that accurate data must be given in regard to the capacity of the plant required and whether it is to be used for ice making, cold storage, cooling liquids or a combination of these, the quantities to be treated in a given time, the temperatures etc. as already mentioned.

Cost of buildings and working expenses.—If information is required on these subjects the current rate of wages, cost of building materials, fuel, etc. should be stated; also the character and quality of water available and—unless it can be had free of cost—the price to be paid for it. In connection with this branch of the subject attention is directed to the remarks on "water distilling" at p. 87.

Specification of plant for an output of 5 tons of ice in 24 hours if used in England or in equivalent temperatures If it is desired to combine ice making and cold storage or cooling, as referred to later on, this is easily arranged.

For smaller ice making plants see Fig. 6178.

The 5 tons plant comprises:

The Engine of the horizontal non-condensing type, complete with the governors and all accessories, and of ample proportions for working the machine to its full capacity.

Double acting refrigerating machine with all recent improvements and of ample proportions.

Two double acting compressors complete with appliances to conduct oil into the compressors and completely lubricate all working parts, seal the pistons, valves and stuffing boxes, and reduce the clearance spaces to nil.

Two ammonia condensors constructed of specially made wrought iron tubes with malleable cast fittings and accessories, all carefully tested before delivery.

Oil cooler similar in construction to the condensor.

Oil and ammonia tanks of wrought iron with crucible cast steel ends.

Connections with fittings for the entire system, including pipes, valves, gauges, spanners, foundation bolts, nuts, washers etc.

Tanks &c.—Wrought iron freezing tanks, wood frame and covers. Wrought iron tube brine cooling coils with fittings.—Rotary agitators and driving gear for agitating the brine in the freezing tanks.

Ice moulds, of galvanized sheet steel, for producing blocks of ice weighing about 200 lbs.

Ammonia, liquid base oil, chloride of calcium &c. to charge the machines.

Cost of plant—The price of a plant of machinery capable of producing **5 tons** of clear ice in 24 hours is about £1320 0 0

The price of a similar plant but capable of producing **ten tons** of ice in 24 hours is about £2450 0 0

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

COLD STORAGE ROOMS.—It will scarcely be necessary to mention the importance of insulation, as complete as possible from the external atmosphere; if reasonable care is exercised in design, construction and maintenance, this is quite easily obtained with comparatively small outlay.

The cooling pipes, whether the cold store is afloat or on land, are arranged as may be most convenient in each case. If they can be fixed in a chamber above the chill room a free circulation of air is induced which clears the room of misty vapours, but they may be fixed in other positions without appreciable inconvenience.

Refrigerating cars, for carrying meat, poultry, fish and other products, vary considerably in design, according to climate and other circumstances but not in principle, the essential feature in all cases being the reduction of conductivity to the lowest limit.

If the time of transit does not exceed about 24 hours, a proper distribution of ice and brine, without any mechanism in the car, gives—in most climates—perfectly satisfactory results. In some cases the ice box is fixed about the centre of the car with brine tanks at each end. In others the ice boxes are at each end of the cooling compartment whilst in a third and still more simple (but very efficient) arrangement, the ice is distributed over the roof of the refrigerating chamber, the brine being carried off automatically when it has become too much attenuated to be useful for cooling purposes.

Train of refrigerating cars.—Under exceptional circumstances where low temperatures must be maintained for considerable periods, it may be necessary to have a train of cars provided with refrigerating machinery, cooling pipes &c.

A train of eight cars each having about 1500 cubic feet of storage space or an aggregate of 12000, cubic feet is easily managed and is (usually) of sufficient capacity.

The compressing machinery is fixed in the front car, complete with boiler and all accessories, or a pipe connection is made to supply the motor with steam from the locomotive as may be convenient, the remainder of the train being cooled by a system of pipes, in which the ammonia is expanded from the machine on the front car without brine or other intermediary.

The cost of such an installation (exclusive of the cost of the cars) is about £1100 0 0

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

SMALL ICE MAKING MACHINES on the ammonia compression system and arranged as shown in Fig. 6178 are constructed to produce the undernamed quantities of ice and for refrigeration of all kinds, including the preservation of provisions and are usually worked without aid from skilled labour.

The blocks of ice vary in thickness from 1½ inches produced by the smaller machine, to 3 inches in the larger machines and, as rough ice frequently answers every purpose, the output of this is given as well as that of crystal ice.

In all cases the plant is tested, before delivery, by making the quantity of ice contracted for and consists of:—

The refrigerator, compressor, condensor, ice tank with ice moulds, brine circulating tubes, pipe connections, valves, Pressure gauges, spanners, bolts, a full charge of ammonia &c.

PRICES OF ICE MAKING MACHINES Fig. 6178.

Output of rough ice per 24 hours ... ... lbs.	500	1000	2200	4400
,, crystal do. ... ... ,,	250	500	1100	2200
H. P. required	1	2	3	4
Price of plant with engine and boiler	£240	£295	£470	£695
Do. do. engine only	£190	£240	£400	£600
Do. for belt driving	£160	£200	£370	£535
Cost of packing &c.	£20	£25	£28	£35
Approximate measurement ... ... cubic feet	220	315	410	620

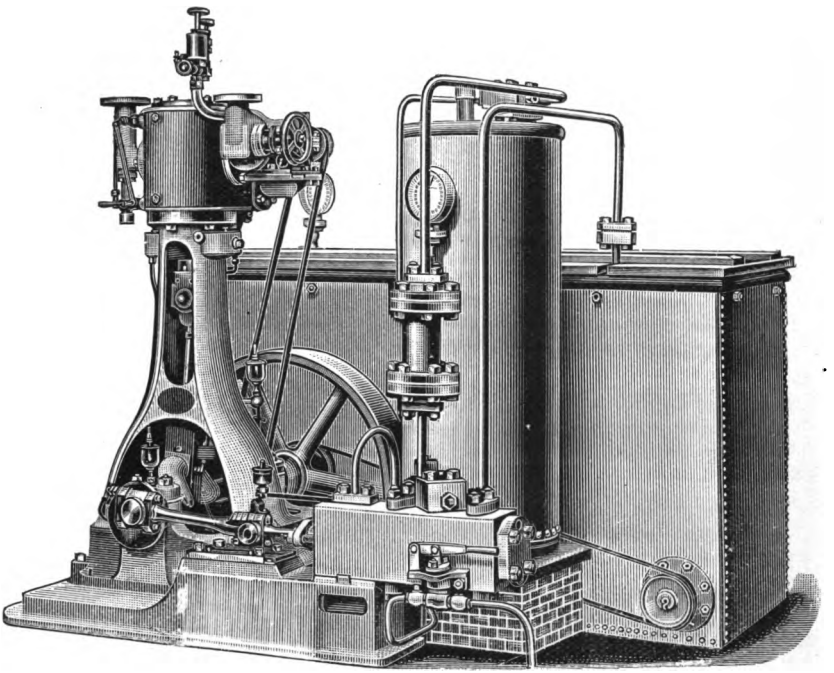


Fig. 6178.

ICE MAKING AND MINERAL WATER FACTORIES.—It is well known that these businesses are frequently combined with great commercial advantage, and if to these be added a distilling plant, the purity of the products is beyond question—See p. 80. If estimates are desired for machinery to occupy existing buildings, advice will be given (if wished) as to the general arrangement best adapted for the buildings, plans of which with figured dimensions, must be provided.

If new buildings are to be erected, it will probably be found economical and convenient to construct them in galvanized iron, marked for re-erection; such buildings, properly designed are quite suitable and can be sent out with the plant, or in advance.

The information referred to elsewhere, with regard to temperatures, &c. is required together with the weight of ice and the number of dozens of aerated water required in a given time.

LAUNDRY MACHINERY.

It has been amply proved, in many large establishments, that the wear and tear of clothes, household linen, etc., which are washed and finished by machinery, is far less than it was when manual labour only was used; also that marked advantage is derived in the cost and the time of washing by the use of machinery well designed and maintained.

Steam laundry plant can, of course, be arranged to suit any conceivable output and if intending purchasers will state what kind of work has to be done and the maximum number of pieces to be turned out in a given time, their wants will easily be supplied.

The plant referred to in the following specification is capable of dealing with 3000 to 4000 pieces of work per week. This quantity is far in excess of the requirements of the permanent residents, but not for those of steamers and their passengers leaving in 24 to 40 hours after arrival. The machinery is therefore in proportion with these exceptional demands and consists of :—

Engine of the horizontal type with steam cylinder, 9 inches diameter, governors, fly-wheel, etc.

Cornish boiler of extra dimensions to supply steam to the laundry and complete with all fittings, including an injector.

Washing machine.—Two rotary machines with copper cage or cylinder arranged to reverse automatically and complete with safety valve and gun metal fittings.

Sudding rollers.—A set of best rubber rollers, cast iron standards and frame, driving pulleys, strap guides, etc.

Blueing and rinsing machine with two compartments, one for clear and the other for blue water, squeezing rollers of india rubber with driving pulleys and striking gear, drip-board and trough with perforated grid and gun metal outlet cocks.

Hydro extractor, over driven and fitted with leather driving cones, driving pulleys and strap guides.

Dashwheel or rinsing machine with fast and loose pulley and strap guides.

Clothes boilers.—Two circular copper boilers in one nest with perforated false bottom, copper steam coil for boiling, gun metal steam cocks and outlet valve.

Soap and soda dissolver of galvanised iron with two compartments, each of 80 gallons capacity, incased with wood and complete with steam pipe and gun metal outlet valve.

Washing Troughs.—Five troughs made of best red deal with perforated false bottoms, coil fittings and connections for steam and cold water and discharge cocks.

Steeping trough as above.

Cold Water tank of galvanized iron, 2,000 gallons capacity.

Hot water tank as above.

Steam donkey pump for general water supply.

Ironing machine with concave bed 108 feet long, cast iron roller, heated by steam and covered with flannel, attachments for carrying off condensed water and all recent improvements.

Cuff and collar ironing machine.

Curtain Dressing machine with four frames and box steam coils, or copper coil, for hot water tank.

Drying closet with ten horses each formed of eight galvanized tubular rods and so arranged that the compartment is closed when the horse is fully withdrawn. The closet is heated by steam pipes with provision for expansion and contraction, steam trap, fittings, grids to prevent articles falling through, etc.

Ironing stove for heating irons, of most economical construction complete with all fittings, fifty irons of various sizes and twelve stands.

Box mangle driven by rack and pinion and provided with stone bottom which imparts a high finish to the linen

Starching machine in two compartments, india rubber squeezing rolls, driving gear, belt guides, etc.

Shafting, &c.—The whole of the shafting, bearings, pulleys, belting, pipes, fittings, spanners, etc. required for completing the work.

The price of the complete plant as specified is £1,875 0 0 and the cost of packing for shipment and delivery f.o.b. is about 5 per cent.

BAKERY PLANT.

BAKERY PLANT.—The improvements made in recent years in the construction of machinery for making bread, biscuits, confectionery &c. have been such that almost all large establishments, naval and military bakeries and many businesses of quite moderate extent, are now fully equipped with machinery by which all processes are carried out with perfect accuracy and without manual labour in handling the products.

The quality of these products is more wholesome than those made by the ancient methods, and there is the further advantage that, by reason of the perfect amalgamation of ingredients, a larger yield is obtained from an equal weight of materials than would be if worked by hand.

Space does not admit of reference to all the appliances required to equip an important bakery, but the principal machines are mentioned, followed by specifications and estimates for installations of moderate extent which are in successful operation.

KNEADING AND MIXING MACHINES are made in various sizes, to treat any quantity of flour from a few pounds to half a ton at one operation, and with mixing gear adapted for many kinds of ingredients, but the engraving Fig. 6179 clearly illustrates the principle on which this valuable invention is based, as well as the type of machine most in demand.

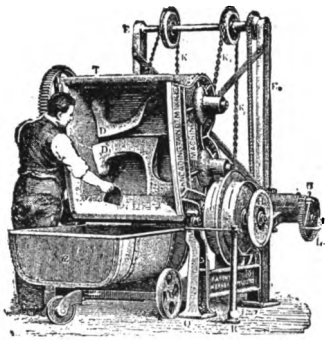


Fig. 6179.

The receiver is shown in position for emptying after the process of kneading and mixing has been completed and—as will be understood by reference to the engraving—this is accomplished (whatever the ingredients may be) by the rotation of blades which rapidly and completely incorporate the materials which have been charged into the receiver. The mixing is greatly accelerated by reversing the action of the blades two or three times during each operation and the belt driven machines are fitted with a motion for that purpose.

The power consumed depends on the speed at which the machine is run and on the stiffness of the dough. The quantities mentioned in the accompanying table are the maximum for the respective machines.

The cost of packing Bakery plant for shipment and delivery f.o.b. usually varies from about 8 to 10 per cent.

PRICES OF KNEADING MACHINES, Fig. 6179.

To mix at one operation	lbs.	90	280	400	800	1100
,, ,, ,, ...	or sacks	¼	1	1¾	3	4
Driving power required	H. P.	1½	3	4	6	8
Output of dough per day	tons	3	6	10	15	25
Price of machine		£56	£90	£127	£168	£187
,, if with automatic turn over		...	...	£151	£198	£218

SIFTING MACHINES.—It is always desirable and sometimes absolutely necessary to abstract all foreign matter from flour or powdered substances before these enter the mixing machine. This is done by a revolving spiral brush driven by belt; the machine is usually fixed over the mixing receiver and is arranged to deliver the cleaned products to it.

PRICES OF SIFTING MACHINES.

Output per hour (flour)	tons	1½	2	3
H.P. required		¼	½	½
Price of machine		£8 5 0	£10 10 0	£17 10 0
,, spare sifters		£0 13 6	£1 1 0	£1 8 6

DOUGH BRAKES (not illustrated). These machines have hard cast iron rollers revolving over a trough shaped table for the purpose of reducing the dough or other plastic matter to uniform thickness. They are complete with motion for instantly reversing or stopping the machine by friction gear, driving pulley, etc.

PRICES OF DOUGH BRAKES.

Length of rollers	inches	16	18	20
Diameter of rollers	,,	4½	6	7
Price of machine		£30	£45	£57

MEASURING AND TEMPERING APPARATUS.—This consists of a wrought iron tank fitted with indexed gauge, thermometer, etc. for accurately gauging the quantity and temperature of the water for mixing, delivery pipe with swivel joint and cock, overflow pipe, etc.

PRICES OF MEASURING, ETC. APPARATUS.

Capacity of tank	gallons	23	40	56	68
Price of apparatus		£12	£14	£15	£16

DIVIDING MACHINES —These are arranged to cut dough or other plastic matter, into almost any number of parts exactly equal in dimensions and weight.

As generally used in bakeries, there are 20 divisions of 1 to 6 ounces each, or 30 divisions of 1 to 4 ounces each.

The price of the machine is £25 0 0

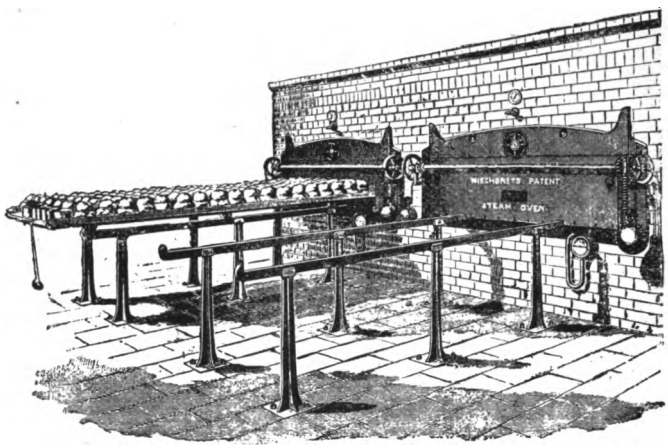


Fig. 6180.

DRAW OUT STEAM OVENS.—The arrangement illustrated by Fig. 6180 offers many advantages in economy in the consumption of fuel, convenience and safety. By a recent improvement, the front of the draw out plate is supported on standards with runners at floor level, so that the fixed stage (shown in front of the oven) is dispensed with and the floor space is left perfectly clear.

The steam heated ovens are fired with gas, coke or almost any kind of fuel, the consumption is very small and it is almost impossible, with ordinary care, to spoil a batch. They are made of any desired proportions and the cost varies with them, but a size of oven very largely used is that to bake 200 2-lb. loaves (1 sack) and the price of the heating tubes, furnace and all other metallic parts for such a furnace is about £180 0 0

"PEEL" STEAM OVENS.—The cost of the ironwork and fittings for an oven of similar capacity on this system is about £120 0 0

BAKERY TO WORK TWO TONS PER DAY.—The machinery referred to in the following specification is in successful operation and is equal to an output of 2000 kilogrammes—say about two tons of bread—per day of 10 to 12 hours; it is not worked continuously to its full capacity, but at certain seasons the demand is largely increased by the influx of visitors, and the output of the bakery then considerably exceeds the contract quantity of 2000 kilogrammes per day.

In ordinary work, the proportions of loaves are about two thirds coarse and one third fine and "fancy" bread and the appliances consist of:—

Spiral brush sifting machine driven by belt.

Dough kneading machine of the type Fig. 6179 of 100 kilo. (about 2 cwt.) capacity with pulleys to drive by power.

Measuring and tempering apparatus.

Trucks with universal runners for transferring a full charge of dough to the dividing machines.

Reversing dough brake with hard iron rollers, frictional reversing gear &c.

Dividing machine for separating lumps of dough weighing 3 kilos (about 6 lbs.) into 30 pieces, at one operation.

Dividing machine as above but to separate lumps of 5 kilos (about 10 lbs.) into 10 or 20 pieces.

Sack hoist, chain and accessories.

Shafting, pulleys, bearings, belts &c. for driving all the machines.

Steam engine with spare power for extensions.

Boiler of extra dimensions to provide steam for all purposes and for extensions.

Steam heated oven with the most recent improvements and suitable for baking every description of bread, complete with all ironwork, fire bricks, specials and fire clay, draw plates, pyrometers, oven light, hot water boiler, circulating tank, steam injection apparatus, &c.

Water lifter to raise water for all purposes.

The cost of the plant is £755 0 0

The cost of packing for shipment and delivery f.o b. averages about 7½ per cent.

BAKERY PLANT TO WORK ONE SACK.—The following outline specification is for machinery, more limited in quantity than was required for the installation last referred to, but capable of producing and treating any quantity of dough up to about 5 or 6 tons per day. The motive power, shafting &c. are provided by the purchaser and not included in the estimate of cost. The machinery consists of:—

A dough kneading machine of the type Fig. 6179 driven by power and of the proportions requisite for mixing any quantity up to one sack (280 lbs.) of flour at one operation.

A spiral brush sifting machine to work by power.

Measuring and tempering appliances as described.

A dough truck to serve as a model for others to be made by the purchaser.

A draw-out steam oven of the type Fig. 6180 and as described, including all metallic work but no fire bricks &c. for setting.

The cost of the plant is about £300 0 0

Or if with Peel oven £230 0 0

About 4 horse power is required to drive the machinery efficiently and the cost of packing for shipment &c. is about 7½ per cent.

KNEADING AND MIXING CHEMICALS &c.

Machines of the type Fig. 6179 are largely used for thoroughly incorporating many ingredients such as (amongst others) those used in the preparation of:—

Gunpowder, dynamite and other explosives.

Drugs, chemicals, &c. in a plastic or semi-plastic condition.

For masticating india rubber, gutta percha, linoleum, glue, &c.

For mixing fatty matters, paints, putty, plastic ink, crucible paste, and other substances.

For treating some of these, the machines must be constructed of metals suitable for the ingredients to be incorporated, whilst for others, the receiver, or the mixing blades, or both must be heated by steam, or refrigerated and provided with the fittings requisite in each case.

If purchasers clearly state their wants, there is rarely any difficulty in complying with them.

PURIFYING AND SOFTENING WATER.

Various methods have been devised for rendering foul and hard water clear and soft, and suitable for use in steam boilers as well as for manufacturing and domestic purposes, but the characters and quantities of water to be treated vary so widely that, in many cases the apparatus should be designed and arranged with special reference to the work it has to do.

Fig. 6181 however represents a self contained apparatus which gives highly satisfactory results with water varying widely in character and quantity and which—at a cost of about one penny per 1000 gallons (about 4540 litres)—automatically purifies and softens water, reducing it from 30° to only 5° of hardness which is quite soft enough for all ordinary purposes.

If chemically pure water is required recourse should be had to distilling apparatus illustrated by Figs. 6182 to 6186.

If samples of the water are sent, together with information as to the quantity to be treated in a given time, the results will be guaranteed. Chemical analysis, however, answers much the same purpose as samples of the water. Information of this kind is required before the cost of the plant can be estimated.

Soft water for boilers. Reference is made in Section I (see remarks on Waterheaters) to the great loss arising from the deposit of scale on the heating surface of boilers, which increases in proportion with the price of fuel. Also to evils caused by unequal contraction and expansion in boilers, due to the inevitable unequal distribution of scale, and to the contingent expenses for frequently opening, cleaning, repairing, &c. The only remedy for these evils is, to remove the matter which forms scale, as far as possible, before the feed water enters the boiler.

Soft water for Factories. &c. The late Mr. Clarke, whose process forms the basis of the apparatus now referred to, established the fact that 1½ pounds of soap must be used per 1000 gallons, for each degree of hardness in water, to produce a "lather." It follows therefore that if the hardness of the water exceeds 20°, the cost of the plant for softening it will probably be saved in from 1 to 2 years.

Plant for purifying and softening water. Fig. 6181 represents an improved form of apparatus for purifying and softening water by the well known Clarke process. It is made of various capacities up to about 2500 gallons (about 11350 litres) per hour; if this quantity is insufficient two or more vessels should be employed.

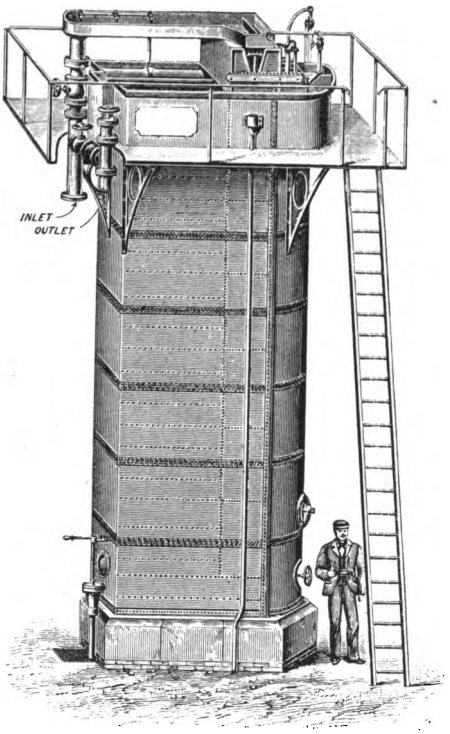


Fig. 6181.

The plant consists of a wrought iron vessel complete with all appliances and works automatically without attention more than once or twice a day.

The mode of working. The water to be treated is admitted at the top, and the inflow is utilised for driving a water wheel enclosed in the casing below the admission trough and so furnishes the power requisite for agitating, &c., a small and adjustable quantity of water being diverted to the lime mixing compartment.

This consists of a trough which is charged with unslacked lime, (usually) once a day. The water passing through the trough takes up a known quantity of lime and, as the flow can be adjusted, it follows that the quantity of reagents is easily regulated to be in the exact proportion with that requisite for softening water of any degree of hardness.

The mixture of hard water and reagents having been made as above described, the whole of the water passes down the mixing compartment and is slowly forced up through the settling tank where the impurities are deposited on angularly arranged plates or shelves from which the matter, so precipitated, falls to the bottom and is removed by blowing off as often as may be necessary—usually once a day.

It will be seen that the process is entirely automatic and may be carried on, if desired, day and night without intermission; also that it is quite immaterial whether a uniform or irregular quantity of water is used in any given time. The supply of softened water may be taken directly from the outlet pipe or from a reservoir if more convenient. In the latter case it will be evident that the output of softened water may be doubled by working continuously and that the apparatus should be arranged so that the supply to the reservoir shall be by gravitation.

Water purifiers. In most cases the apparatus is similar to that indicated in Fig. 6181 and above described, but if the water is soft enough without being treated with reagents, the appliances for this purpose are omitted. The mode of working, removal of precipitated matter, &c. is practically the same as for purifying and softening.

WATER DISTILLATION.—The appliances now referred to give a maximum surface in a minimum space and are perfectly accessible for examination and cleaning—sometimes desirable where the circulating water is (comparatively) foul.

Larger installations for "feed make-up," and for producing quantities of potable water in excess of those mentioned in the following tables must remain subjects for special arrangement. In connection herewith it may be well to point out that a series of small distillers are frequently used in lieu of one large one. If for instance—the quantity required varies, with a maximum of 30,000 gallons per day, six distillers each equal to an output of 5,000 gallons, or three of 10,000 gallons capacity, will supply the maximum demand, a smaller number being worked when desirable.

Cost of working.—This necessarily varies in proportion with the quality of fuel and the temperature of the water used for condensation, but the following data on which the duties and prices given below have been based—will probably suffice for the purpose of approximate estimate, ample allowance being made for inferior fuel (if necessary) and for variations in the temperature of the condensing water available.

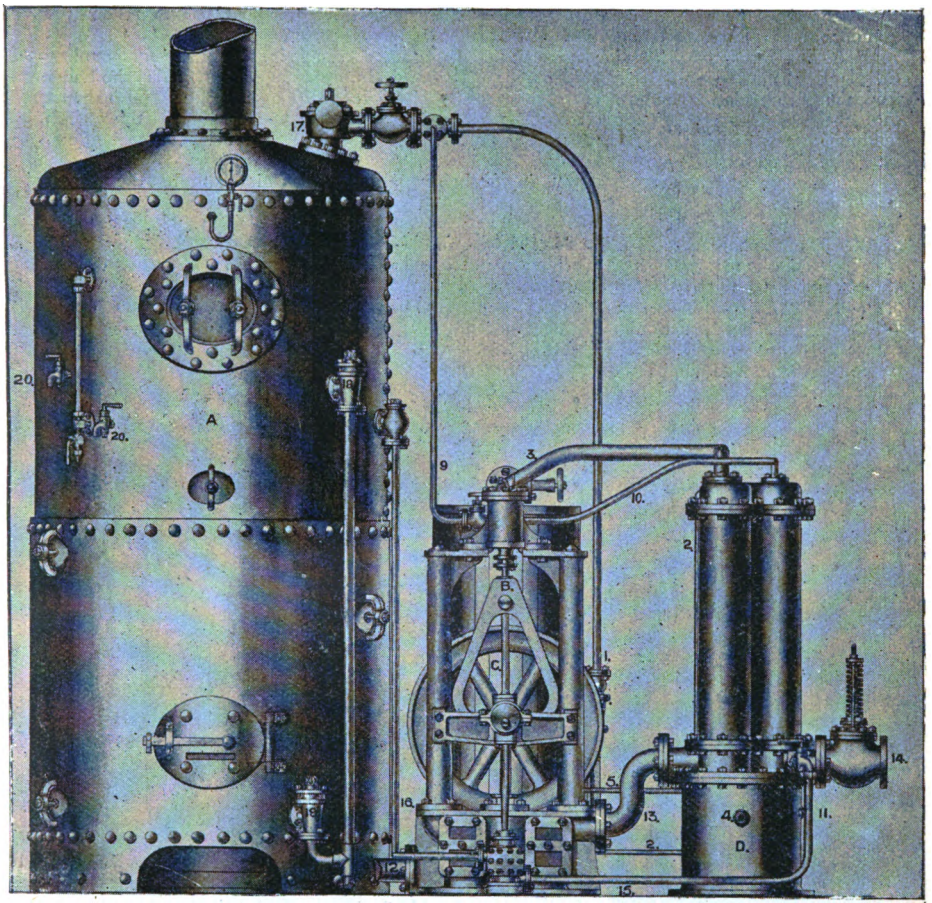


Fig. 6182.

The most perfect type of distilling plant, with vaporiser, illustrated by Fig. 6182 and described on the following page, produces 12 lbs. of distilled water for each lb. of good coal consumed, and the other types 6183, 6184, 6185, and 6186, without vaporiser, about 7 lbs. of water per lb. of coal.

These results are obtained in England and, allowing for differences in temperature, quality of fuel &c., the average yield may be assumed to be about 6 lbs. of distilled water per lb. of coal, the quantity of condensing water used being about 9 gallons (90 lbs.). This is equivalent to about 1·7 lbs. of coal and 15 gallons (150 lbs.) of water for condensation, for each gallon of distilled water produced.

The process is practically automatic, and the cost of working including maintenance, depreciation &c. is quite insignificant.

Temperatures.—Grave inconvenience has (in the writer's experience) been caused by incorrect information with regard to the temperature of the condensing water to be used ; this occurred in connection with a large installation which he had designed and erected and the fact is mentioned in illustration of the importance of accuracy in stating the maximum and minimum temperatures of the water available.

WATER DISTILLING PLANT.—The compact and economical arrangement shown in Fig. 6182 with evaporator, is made of all capacities up to about 10,000 gallons per 24 hours and produces 12 lbs. of distilled water per lb. of coal consumed.

The apparatus comprises the boiler and all fittings and connections requisite for coupling the plant but not those to supply water main, or to sea, drain, or storage tanks. Also the boiler feed pump, circulating pump, evaporator neatly cleaded, distilling apparatus and exhaust cooler, the necessary tools, non-conducting material to cover the boiler 2 inches thick, iron retaining bands, black varnish &c. The plant is complete with dirt arrester, charcoal filters, &c. as described further on, (Fig 6186).

The references in the engraving relating to the several parts clearly indicate that the process is as follows:

The steam generated by the boiler A passes to the evaporator C by the pipe 1 and thence to the distiller by outlet 2, the circulating and boiler feed water being supplied by the combined pumps B.

Three, is the vapour outlet from the evaporator to the distiller; 4, the drinking water outlet; 5, the feed inlet from the evaporator to the distiller; 6, drain cock; 7, mud door; 8, safety valve; 9, steam inlet to combined pump; 10, exhaust outlet to distiller; 11, greasy fresh water outlet for washing &c.; 12, suction to circulating pump; 13, circulating delivery to distiller; 14, circulating discharge through weighted valve; 15, suction from distiller to feed pump; 16, delivery from feed pump to boiler; 17, safety valve; 18, scum cock; 19, sludge and drain cock; 20, test cocks.

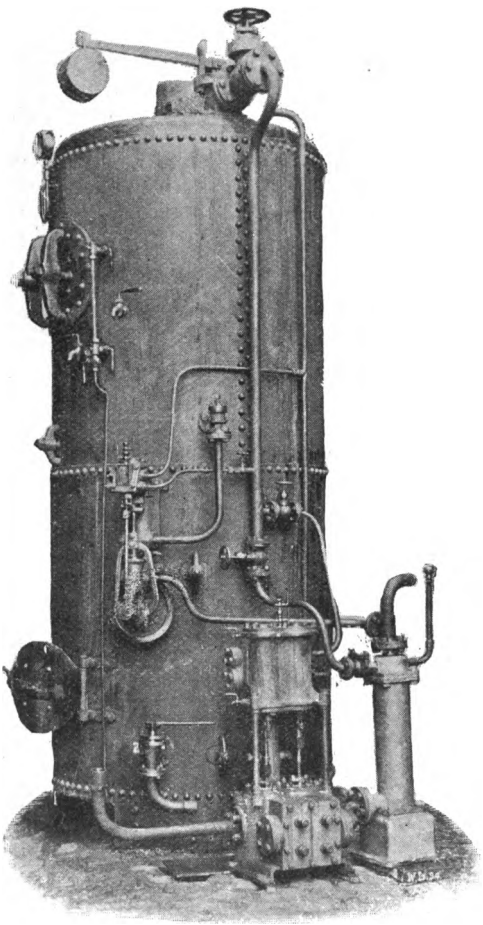


Fig. 6183.

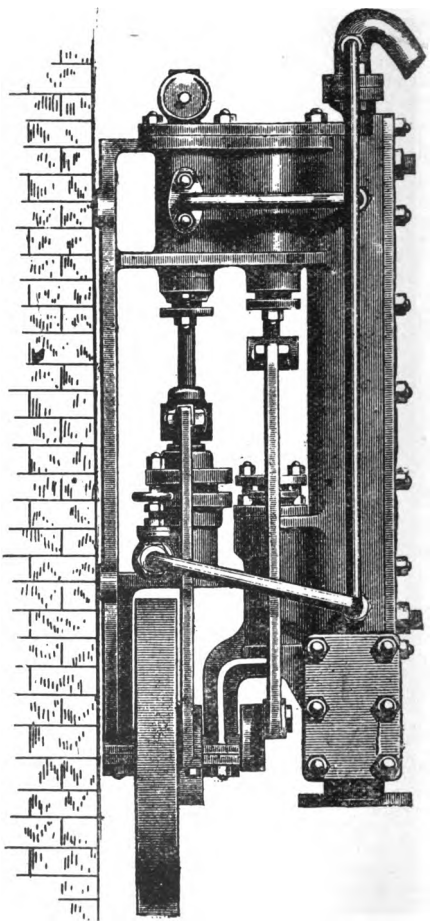


Fig. 6185.

PRICES OF DISTILLING PLANT WITH EVAPORATOR Fig. 6182.

To distil in 24 hours ... gallons	1000	2000	3000	4000	5000	6000	8000	10000
Price of Plant	£240	£300	£400	£520	£620	£735	£1120	£1415

WATER DISTILLING PLANT of the type Fig. 6183 is made of various capacities and produces (see general remarks) about 7 lbs. of distilled water for each pound of coal consumed. and comprises :—

The boiler with all fittings and connections including those for condensing the steam from the circulating and the donkey feed pump. It will be understood that the boiler may be fixed in any position relatively with the circulating pumps and distillers and that these may be used singly, or in groups, as desired.

The distiller shown on the right of the engraving and in section by Fig. 6186, contains a nest of corrugated copper tubes, dirt arrester and charcoal filter, from which the distilled water flows nearly cold and ready for consumption or storage.

The plant is complete with every accessory excepting the connecting pipes to supply main or sea, and the delivery pipes from the distiller to storage reservoir.

PRICES OF DISTILLING PLANT, Fig 6183.

To distil in 24 hours ..gallons	1000	2000	3000	4000	5000	6000	8000	10,000
Price of plant	£180	£290	£380	£450	£550	£700	£1030	£1325

DISTILLING APPARATUS WITHOUT BOILER.—The plant illustrated by Fig. 6183 is supplied ready for connection with any existing steam supply and the prices are, in that case, largely reduced.

DISTILLER AND PUMPS COMBINED.—The arrangement illustrated by Fig. 6185 is specially adapted for domestic or other supply, limited to about 500 gallons of potable water per 24 hours.

The distiller, circulating and steam feed pump are combined in one casting, with back plate for attachment to an existing boiler, or other support, as shown in the engraving.

The whole of the steam, (including that used in the circulating and feed pumps) is passed to the distiller on the right of the engraving, so that all is utilized. The internal arrangement is as shown in Fig. 6186.

The price of the apparatus, Fig. 6185 is £58 0 0
If with boiler and all mountings £160 0 0

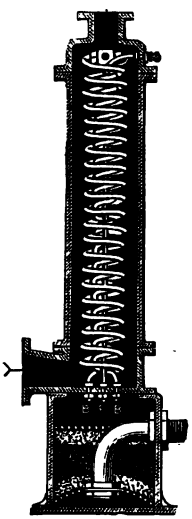


Fig. 6186.

WATER DISTILLERS are made singly, as shown in Fig 6186, or in groups, as required, with circulating water supply common to all.

The casing contains a nest of solid drawn copper tubes coiled as seen in the engraving and connected, at the upper end, with the steam supply pipe. The cooling water enters at the lower part of the casing and, flowing upwards, condenses the steam in the coil which passes from the filter as pure and nearly cold water.

The base of the apparatus contains a charcoal filter through which the water percolates, and so becomes aerated and rendered quite palatable and ready for storage or consumption.

PRICES OF DISTILLERS, Fig. 6186.

To distil in 24 hours, gallons	1500	2500	4000	6000	8000
Price of apparatus	£16	£27	£40	£52	£80

The cost of packing distilling plant and delivery f.o.b. is about 5 per cent.

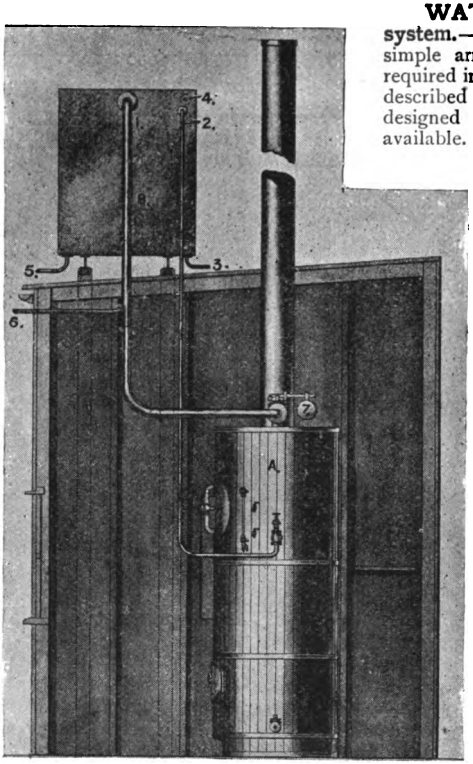


Fig. 6184

WATER DISTILLING—Gravitation system.—Fig. 6184 represents an extremely simple arrangement (in which the mechanism required in connection with the systems previously described is dispensed with) and specially designed for use where no skilled labour is available.

Working at atmospheric pressure, the apparatus produces about 7 lbs of distilled water per lb. of good coal used and it is immaterial whether the cooling water is clean or dirty, that obtained from a mine, canal or other source answering every purpose.

The plant consists of a vertical boiler which is lagged to prevent loss by radiation and all fittings, connections and tools; also a large galvanized iron circulating tank with tinned copper cooling coils and all necessary attachments.

The prices for plant to work on this system, with boiler fired with coal, are the same as those for Fig. 6183. If other fuel is to be used the kind (or the heating properties), should be clearly defined.

The vapour from the boiler **A** is conveyed by the pipe 1, to the condensing tank **B**, 2, is the feed pipe to boiler from the cooling water in the condensing tank; 3, is the cooling water inlet; 4, is the cooling water outlet; 5, overflow and drain pipe; 6, distilled water outlet to storage tank and 7, a dead weighted safety valve.

MINERAL WATER MACHINES.

The set of machinery illustrated by Fig. 6187, is arranged to work by steam or hand power the output in each case being that obtained when worked by steam power. Machinery of the old type still does good service but that illustrated comprises several recent improvements designed with a view to erection and working by unskilled labour. Large numbers have been erected and worked under these conditions and produce excellent waters, thoroughly aerated.

Amongst the advantages claimed for this type of plant may be mentioned the absence of liability to deterioration by contamination, and that it is complete with all appliances and ready for work as soon as it has been charged. It comprises:

The generator, shown on the right, with fittings and connections in which the carbonic acid gas is made.

The gasometer in which the gas is stored for use. And

The machine, on the left, in which the gas and water are completely mixed at any desired pressure.

The foregoing brief explanation, in conjunction with the engraving will sufficiently indicate the cycle of operations and it will only be necessary to add, that the capacities referred to in the list are for large bottles aerated to the pressure usual for lemonade and similar waters, the machine being driven by steam.

The gas detector shown in the engraving, is supplied at an extra cost of £3 5 0 for any of the machines.

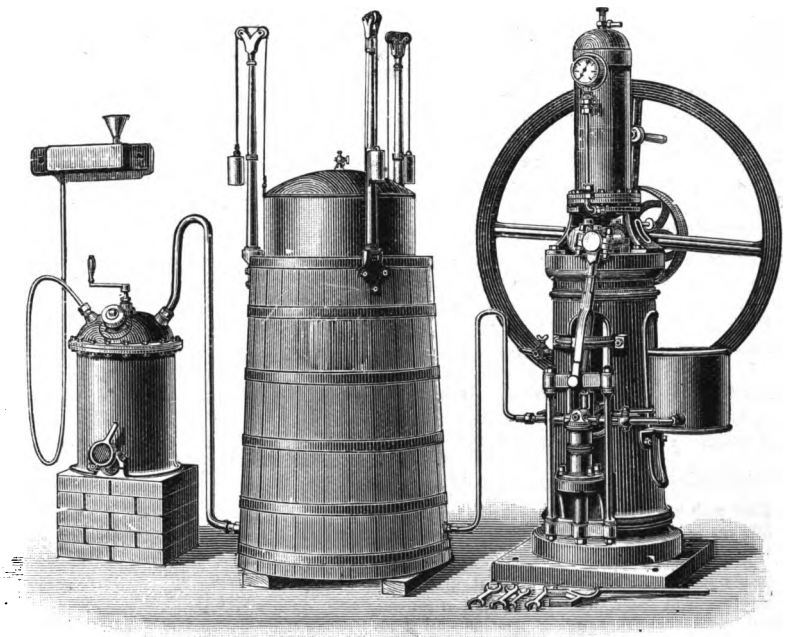


Fig. 6187.

PRICES OF MINERAL WATER MACHINERY Fig. 6187.

Capacity per day .. .. dozens	300	450	600	1200
Price of machinery complete	£45	£50	£70	£85
Price of machine only	£30	£35	£50	£60

The cost of packing for shipment and delivery f.o.b. varies according to destination but probably will not exceed 10 per cent.

PLANT FOR MINERAL WATER FACTORIES.—The specification of plant necessarily varies according to the output required.

That now given, as an example of a useful installation, is for the appliances requisite for producing 600 dozen large bottles per day when worked by steam power.—The plant comprises:

A set of machinery as Fig. 6187, gas purifier, water regulator, acid syphon and stand, turnover filling machine with syrup pump, filter bags and stands, syrup jars with taps, pestle and mortar, glass measures, saccharometer and test glass, bottle washing machine for 15 dozens, bottle brushes, low pressure filter, galvanized tank, three way syrup junction, essences, colouring ingredients, tin pipe &c.

PRICES OF MINERAL WATER PLANT.

Capacity per day .. ..dozns	450	600	1200	3000	4500
Price of plant complete	£83	£136	£206	£415	£615

The cost of packing &c. will be as above named.

BOTTLES &c.—The proper equipment of bottles with ball screw stopper or corks, boxes &c. will be sent if desired and charged at current prices.

REFUSE DESTRUCTORS.

The rapid destruction of town refuse by some system which will render it innocuous must, in the near future, occupy the attention of the sanitary authorities in all large communities and, although the wants of each district must be separately considered, it may be well to indicate the general features of such installations.

There is a general concurrence of opinion that street refuse should be destroyed with as little delay as possible and that, if practicable, advantage should be taken of any useful effect derivable from its destruction, as a set off to the expense of collecting, etc.

It consists largely of combustible matter and, when we consider that the quantity of refuse in several districts of London averages about 260 tons per annum per 1000 of population, it is evidently desirable that the heat developed in burning it, should be utilised.

The calorific value of cremated refuse has been variously estimated at, 1 lb. of refuse evaporating from 1 to 5 lbs. of water; the lower estimate is probably too low and the higher too high, as an average; this seems to be from 2 to 2½ lbs.—*i.e.* 1 lb. of refuse may be expected to evaporate 2 to 2½ lbs. of water.

The quality of refuse varies considerably in different localities and is perhaps 25 per cent. higher in winter than it is in summer and these facts probably account for the discrepancies in the estimates of calorific value. It is also affected by the manner in which it has been screened or separated.

Noxious vapours.—Amongst the arrangements devised for rendering innocuous the vapours arising during the combustion of the refuse, probably burning them—although involving some expense—is the most economical in most cases.

The ash and clinker also varies in quantity but usually averages about 25 to 30 per *cent.* The clinker is available for road ballast or when crushed for making street paving by mixing with cement.

Utilization of steam.—In what manner the steam generated in the destructor boilers shall be profitably used, must be a question for decision in each locality. Driving electric motors seems an almost involuntary suggestion and if an installation of machinery for generating and distributing hydraulic power, for pumping, supplying steam to baths, warehouses, laundry, &c. can be combined with an electric lighting installation, it is evident that the heat generated in the process of destruction, established for sanitary purposes, may be advantageously employed.

The cost of destruction is influenced by many circumstances such as the nature of the buildings and plant, their extent and completeness and so forth, but the following approximate estimate for buildings and appliances for dealing with about 400 tons of refuse per week may be useful, as an example.

The plant would comprise eight refuse destructor furnaces, six boilers with all fittings and connections, including movable fire bars and forced draft, machinery, storage tanks, chimney, feeding floor and hoppers, coaling and cleaning floor, etc. This installation would develop about 900 brake horse power and the cost, exclusive of site, would be about £15,000 0 0

FUMES DESTRUCTOR.—A simple and efficient apparatus designed and erected by the writer, may be used with advantage in connection with refuse destructors or any branch of manufacture in which noxious fumes are produced.

The circumstances which led to the construction of the apparatus were as follows: It was imperative that the odours arising from the evaporation of certain ingredients should be condensed or otherwise rendered innocuous and that they should not (as hitherto) pass direct into the chimney stack. The chimney had (by calculation) ample proportions and height, but under some atmospheric conditions the fumes descended and were unquestionably unpleasant, if not unwholesome.

Various devices were considered and that eventually adopted was one of exhaustion and condensation.

For this purpose the close fitting cover of the evaporating pan was connected, by a pipe, with an exhaust fan of the type 3153 (see Section 4). The fan exhausts the vapours from the pan as they are produced and projects them into a closed vessel which is supplied with water in a continuous stream; this, descending through finely divided and evenly distributed jets, combine with and completely condense the objectionable vapours, the effluent water passes into the ordinary drain and repeated analyses have failed to discover any trace of contamination.

The plant can be arranged to suit almost any conditions and to treat large or small volumes of fumes and does not require a tall chimney.

SMOKE DESTRUCTORS.—An arrangement similar to that last referred to, is successfully used for condensing smoke and fumes from furnaces and for collecting the residual products, some of which have considerable commercial value.

The unconsumed products are exhausted by a fan, which projects them into a closed vessel or tank where they are subjected to the action of water in the manner already described.

The tank is provided with agitators which cause the soluble matter to combine with the water and finally form a liquid which contains valuable disinfecting, deodorizing and fertilizing properties. The insoluble matters are deposited in the tank and are collected from time to time.

If ordinary smoke is treated, the residual products are highly charged with fixed carbon which is saleable.

If the apparatus is used in connection with smelting furnaces all products, which usually escape into the atmosphere, are arrested, including any particles of valuable metal which have been carried over with the fumes.

The destructor is made of all capacities and is applied, at moderate cost, to furnaces of any kind, without disturbing existing chimneys, flues &c.

The vapour emitted is nearly colourless and the dimensions of the chimney may be much less than will be necessary if the destructor is not used.

Application for prices should be accompanied by information relative to the quantity of coal consumed, or the volume of gases to be treated in a given time and on such other matters as require consideration.

STEEL MAKING PLANT.

BESSEMER STEEL MAKING:—The machinery and appliances requisite to produce 700 to 800 tons of Bessemer steel tin plate bars per week consists of:—

A blowing engine and ten boilers with fittings, pipes, valves, etc.

Two Bessemer convertors and accessories, including hydraulic centre lift for pit, and two ingot cranes.

Hydraulic pumping engine, accumulator and connections.

Four furnaces.

Cogging mill and engine with pipes and fittings, as above.

Three high finishing mills with engine, etc.

Rolls for mills. Floor plates and accessories.

Two Rastrick boilers with pipes, etc. as above.

Tools, weighing machines and sundry fittings.

Cost of machinery.—The approximate cost of plant to the foregoing outline specification, at the present prices of materials, etc. is £20,000 0 0

Buildings and plant,—Assuming that exceptional outlay is not required for foundations, the cost of works, including buildings, roofs, chimneys, offices, etc. may be estimated at about £27,000 0 0

Merchant bar or plate mills.—If the epuipment includes the appliances for turning out merchant bars or plates, the weight of tin plate bars being proportionately reduced, the extra cost of machinery and iron work will be about £3,250 0 0

Packing for shipment and delivery f.o.b. may be estimated to cost 3 per cent.

SIEMENS-MARTIN STEEL MAKING.—A plant capable of producing 170 to 200 tons per week of tin plate bars, or 150 to 170 tons of merchant sections, in highly successful operation, consists of:—

The furnace, gas producers, travelling ladle etc.

Engine, boiler, pump and acumulator.

Cogging and finishing mills, with engines and fittings.

Rolls for mill, floor plates, 5 tons locomotive steam crane, tools, weighing machines, etc.

Cost of plant.—The approximate cost of such a plant is .. £13,500 0 0

For cost of buildings, shipping, etc. see "Bessemer steel making."

BLAST FURNACES, equipment and arrangement.—It would be interesting, if space permitted, to trace the origin of the numerous and vast improvements made in blast furnace plant since the first cannon was cast in England in 1543, and to refer to variations in the types of furnaces and their accessories, in this and other countries, during the last 50 years. But the present remarks must be limited to furnaces of the Cleveland type which, with modifications to suit local conditions, are now almost universally adopted.

Location.—Since furnace lifts were introduced, the value of the hill side arrangement has disappeared and the considerations which now influence the choice of site are—good access, ventilation, water supply and drainage and, with these, every facility for removing and depositing the waste products.

Arrangement.—Whether the ores and fuel shall be loaded into barrows or small trucks direct from the railway trucks, or stored in bunkers, must largely depend upon the certainty, or otherwise, of continuity in the supplies of ores. If they are brought by rail ample storage ground for trucks should be provided. If, however, they are brought by water, one or two quick working steam cranes will rapidly and economically make the transfer to the trucks or bunkers, as the case may be.

If the present practice is adopted of having the calcining kilns quite near to the furnaces, space between should be arranged for this purpose. It may be said that the modern tendency is to make the plant for each furnace complete and has much to recommend it. So also has the underground system of gas flues which are used in new installations in lieu of overhead pipes.

Furnaces.—Those now referred to are 85 feet high from hearth to platform level, the diameter of the bosh is 28 feet and the cubical contents 30,000 cubic feet. The average output is 490 tons per week.

Furnace hoists for raising the trucks to the tops of the kilns and for delivering the calcined ore to the blast furnace are of the vertical type, but it is almost always desirable to construct them to suit the varying conditions to be fulfilled.

Calcining kilns.—The Cowper and the Whitwell system of kilns brought about so large a reduction in the consumption of fuel that, for all practical purposes, the pipe stoves may be relegated to the past.

Some modifications have been introduced in both systems for the purpose of readily cleaning out when working with dusty gas, such as that produced in making ferro-manganese, etc., but these may be regarded as details which, for the present purpose may be merely mentioned.

Pressure of blast.—This naturally varies according to the ores smelted and other circumstances, but from 4 to 6 lbs. pressure of blast at the tuyeres gives excellent results in many iron making centres. This, however, is far below that commonly used on the American Continent.

Blowing engines.—It is needless to insist on the importance of having thoroughly efficient blowing engines. Whether they shall be vertical or horizontal, and have proportions sufficiently in excess of those necessary for the regular work to admit of one being laid off for temporary repair, the others in the meantime doing extra work, must be determined by the purchaser. The vertical construction is now usually adopted and experience indicates that the best results are obtained by having an engine for each furnace, equal to its normal duty, with one spare engine for contingencies. This arrangement is contemplated in the estimates given later on, in which four blowing engines are provided to serve three furnaces.

Boiler firing.—The construction of the boilers must be determined after consideration of the quantity and quality of gas available. Those referred to in the estimates are of the double flue type with cross tubes, the gas having been ignited in a combustion chamber before it passes to the boiler.

Output.—As already indicated, this is about 490 tons of pig iron per furnace, per week and the materials consumed in the production of each ton of iron is as follows :—

Coke	20.35 cwts.
Calcined ironstone	46.11 ,,
Limestone	10.71 ,,
Coal for calcining, about	4 ,,

Slag disposal.—The arrangements for this purpose necessarily vary according to locality, the use (if any) to which the slag is put and so forth. In the present case it is run into moulds placed on trollies, which are traversed by an overhead hauling chain.

This works well and is economical, but in other cases a portion, at least, of the slag is made directly into slag wool—so useful as a non-conductor of heat and sound—materials for making concrete blocks and for many other purposes.

Labour saving appliances.—Periods recur when the Iron-master can make satisfactory profits but, they are so brief and so infrequent that in this country his average profit is extremely small. Costs can be much reduced by the use of mechanical appliances instead of manual labour and the writer deems himself fortunate in having been able, on many occasions, to indicate means whereby the cost of production has been sensibly reduced; in more than one instance the savings effected on existing contracts have entirely recouped the cost of the plant provided for that purpose.

Buildings, fittings, &c.—The following alternative figures, based on the present prices prevailing in England, give the cost of the plant with all accessories carried out in a complete and substantial manner.

Specification of blast furnace plant.—The following estimates for three furnaces, of the dimensions already specified and producing an average of 490 tons of pig iron per furnace, per week, is compiled from one of the able papers by Sir Bernhard Samuelson read before the Iron and Steel Institution and comprises:

Three blast furnaces with bells, hoppers, winches, water boshes, pipes, slag bogies &c.
Two furnace hoists, hoist engines, houses, cages and accessories.
Six Cowper stoves with all brick work, valves and fittings. chimney and flue for stoves.
Fourteen single flue boilers with fittings, gas inlets, and chimney for boilers &c.
Four 78 inch blowing engines, engine house and tank, cold blast main relieve valve &c.
Hot blast and horse shoe mains, gas down comers and flues.
Three donkey pumps for tuyere water and three double ram steam pumps for feed, superheaters reservoir pipes, etc,
Five calcining kilns, kiln lift, cage, balance weights, kiln gantry, kiln drop, shafting, brake, etc.
Bunkers, three coke and one coal hopper.
Accessory plant consisting of two locomotives, metal bogies, charging barrows, weighing machines and house.
About two miles of railway line, iron wagons and portable 5 tons crane.
Shipping wharf constructed of timber and equipped with rails, locomotive steam crane, etc. for discharging ore and materials and delivering iron.
Slag delivery wharf, two slag barges, railway trucks, slag bogies, mooring dolphins, and necessary accessories.

The cost of such a plant, at the present prices of materials and workmanship is about £73,500 0 0 and the cost of packing for shipment and delivery f.o.b. may be estimated at about 3 per cent.

If the bunkers, railway sidings, shipping wharves, cranes, etc. are not required, the cost would be reduced by about £15,500 leaving the total cost about .. £58,000 0 0

CIDER OR FRUIT PRESSING.

CIDER AND WINE SCREW PRESSES.—The press box is made of oak, strongly hooped and arranged to be completely removed for cleansing or other purposes. The pressure is applied by a screw with square thread and worked by a ratchet lever.

The stand may be in timber or of iron with an enamelled receiver which is entirely unaffected by the acids in the juices extracted so that these are in no way deteriorated in colour, flavour, or value.

The capacity of the presses is given in gallons which are equal to about 4·5 litres and the same type of press is made of larger capacities up to 1000 gallons.

PRICES OF CIDER AND WINE SCREW PRESSES.

Capacity of press ..gallons	50	70	130	200	250	350
Ditto ditto .. litres	227	318	590	908	1135	1590
Price with iron frame	£9	£11	£17	£24	£29	£40
Ditto wood do.	£11	£15	£18	£25	£33	£48
Approx. measurement cubic feet	24	28	50	55	65	80

Packing for shipment and delivery f.o.b. costs 7½ per cent.

CIDER MILLS with pitch pine frame, pennant stone rollers, automatic feed and springs, to allow hard substances to pass without injuring the mill, are made to work by steam or horse power at the following prices:

Mill to work by steam power and capable of treating about 100 bushels (36 hectolitres) per hour price £20 0 0

Mill to work by horse power and capable of treating about 20 bushels (7¼ hectolitres) per hour, price £18 0 0

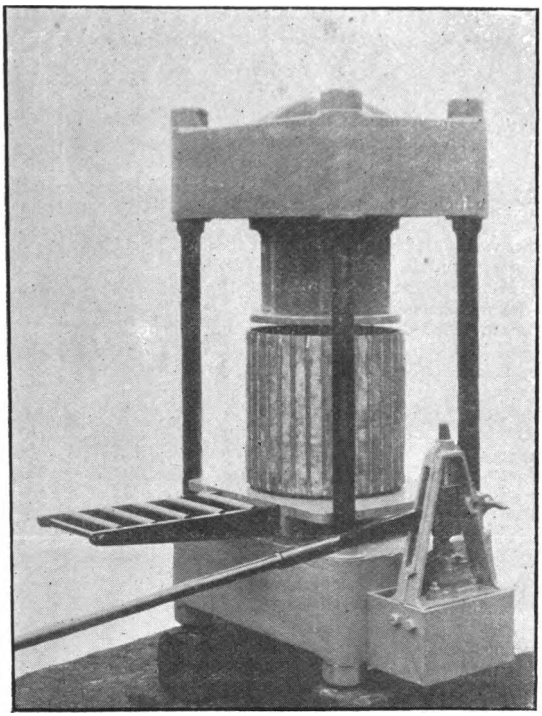


Fig. 6190.

Hydraulic Fruit Press, Fig. 6190, illustrates an improved form of press for extracting the juice from apples, pears, currants and various other fruits, or equivalent matter from other substances.

The top casting is supported on four mild steel columns as shown and the bottom casting contains the hydraulic cylinder in which the ram works. The rising table is attached to the top of the ram and when this is caused to rise by the application of hydraulic pressure in the usual manner, it carries with it the box containing the materials to be submitted to pressure.

The cylindrical head which projects below the top casting has nearly the same diameter as the press box and, as this rises, all fluid matter is gradually expressed and collects in a suitable receptacle from which it is withdrawn from time to time, as necessary.

The rising table is provided with a set of live rollers to afford facilities for withdrawing the box or emptying and for refilling, without having to lift it for each operation.

The pump which supplies the hydraulic pressure is complete with long lever to be worked by one or more men or prepared to receive a connecting rod to be worked by power; also with suction, delivery and relief valves, the latter having an adjustable weight for regulating the pressure to the extent desired. The base of the pump forms a tank and this is secured to the bed plate so that the press with pump and connections is entirely self contained.

If a number of presses are employed in a factory for treating the same or different products, it may be desirable to lay on a system of hydraulic pressure and exhaust mains and work through an accumulator supplied by one set of pumps, as described in connection with the baling presses Fig. 6127, oil mill plant, etc.

PRICES OF FRUIT, ETC. HYDRAULIC PRESSES, Fig. 6190.

Diameter of ram .. .. inches	4	6	9
Length of stroke .. .. ,,	10	12	14
Price of press with box	£55	£80	£110

The cost of packing for shipment and delivery f o.b is about 5 per cent.

PORTABLE FRUIT MILL to press grapes, olives or other berries, with cast iron frame, wood hopper, fly wheel, timber under carriage and with or without transport wheel.

The mill can be worked by a boy and the price is £5 0 0
If with transport wheel and pedestals £5 10 0

The cost of packing for shipment and delivery f o.b. is about 5 per cent.

JUICE AND TINCTURE PRESSES.—The press box is made of oak secured by external wrought iron bands. The bed plate is of iron and the receiver is enamelled. The pressure is put on direct by a screw with cut square thread and worked by a double ended handle. The press is also available for filtering under pressure.

The price of a press of 6¼ gallons (about 29 litres) capacity is £4 0 0

CIDER AND WINE FILTER.—Although when working on a small scale, the filtration for cider or wine making can be accomplished by the old systems, it is not done so well by them as it is by the apparatus now referred to, and no plant for treating large quantities of fruit or liquor can be considered complete without this closed and self contained filter.

The apparatus consists of a cast iron closed vessel with ends easily removable for cleansing and for renewing the fibrous paper pulp which is solely used as the filtering material. The liquor to be treated is delivered into the filtering vessel by gravitation or by a pump, as may be convenient, it is conveyed through a closed pipe on one side and rapidly passes through the filter to the delivery pipe on the opposite side of the vessel, bright and clear, however thick the liquor may have been when it entered the filter. The complete operation being carried out in a closed vessel there can be no contamination or loss of alcohol or bouquet.

A machine with a capacity of 300 gallons per hour will do quite as much work per day as 250 ordinary bags. The quantity treated in a given time necessarily varies with the kind of liquor to be filtered, the capacities mentioned may however be regarded as a fairly high average and it will be understood that, if the inlet cock is closed, the liquor may remain in the vessel for almost any length of time.

The following prices are for the machine complete, including filtering material for two chargings and apparatus for washing and renovating the filtering material for further use. The price of filtering material is 1/6 per lb.

Prices of larger sizes than those mentioned in the list will be given, if desired.

PRICES OF CLOSED CIDER AND WINE FILTERS.

Capacity per hour	..gallons	200	300	450	550	750
,, ,, ,, ...	.. litres	908	1363	2044	2498	3407
Price of filter and accessories		£65	£94	£127	£155	£190

The cost of packing for shipment and delivery f.o.b. of the filters, presses, etc. is usually about 5 per cent.

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